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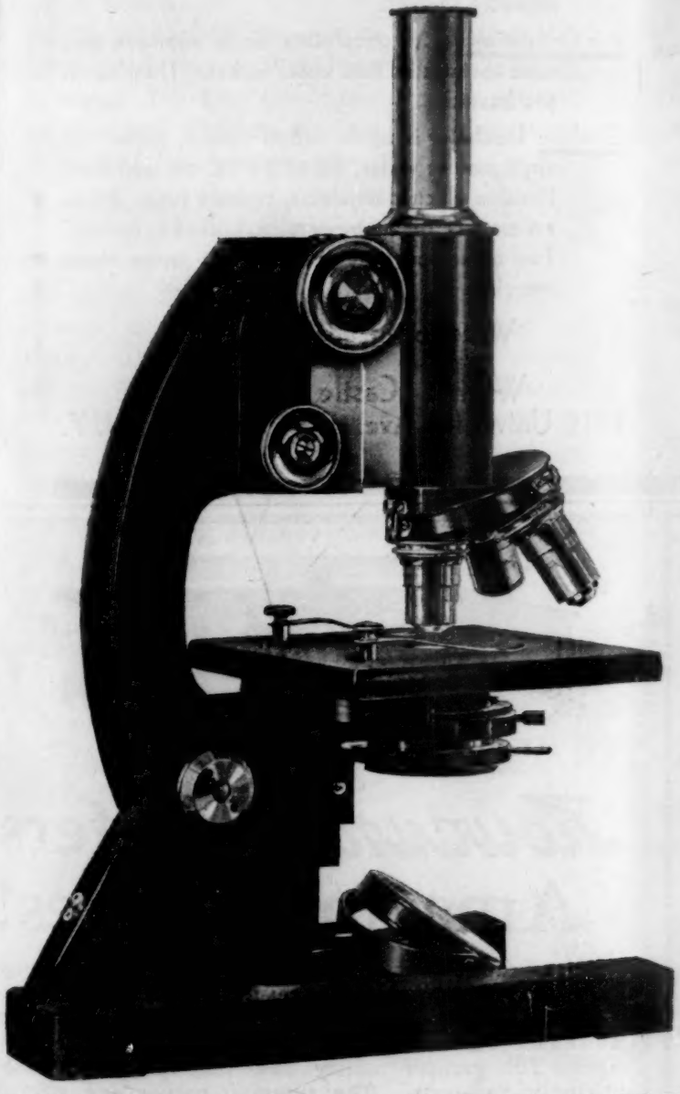

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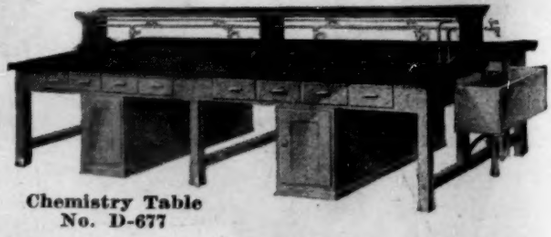

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EUTOPOTROPISM:—SENSE TO FIND THE FIT PLACE[1]

By Professor ALFRED C. LANE

TUFTS COLLEGE

MY subject is Eu-topo-tropism. I imagine some of my profaner hearers will be inclined to say, "What in hell is eutopotropism?" To which I would reply, "It is not in hell."

Others more literary may ask, "In what dictionary is it?"

To which I would reply: "It is not in any dictionary. I made it up." I made it up to shock you so that you will remember the idea, for although the word is new, the idea is not.

Eutopotropism is the tendency or sense to know where you are well off and go there, the sense to find the fit place. It is the opposite of the trait exemplified by the June-bug who will "buzz and butt his head against a wall" or the moth that "shrivels in the fire."

I have an aim or a purpose, and my action is not determined by the past, but is determined by the future. I will call it by a word that you never heard before, that I invent for this occasion, eutopotropic. It means turning to the place where you are well off. The capacity to be eutopotropic is a sign of intelligence. For evolution by natural selection to work there must be three things —a variation, an environment where that variation fits, and, third, a disposition to occupy that environment. It is this third factor that I call eutopotropism. An extra coat of hair fitting an elephant to be a mammoth and live in the Northern part of Asia would not lead to a race of mammoths unless with the extra hair went a disposition toward a northern climate. It is this sense

[1] Address of the president of the Geological Society of America given at Tulsa, Oklahoma, December, 1931.

enough to know where you are well off and go there that I call eutopotropism.

Such behavior leads us to infer intelligence, whenever we can more easily infer actions from aims in the future than from causes in the past.[2]

The derivation is obvious to one familiar with English science or Greek roots. Heliotrope is the flower that turns toward the sun. At the Tropic of Cancer the sun turns backward in the heavens. The biologists have a string of terms ending in "tropic" and "tropism." A "tropism" is a turning, or an inherent tendency of a living organism to turn in response to an external stimulus.

J. Loeb, in his book on "Forced Movements, Tropisms and Animal Conduct," has a long list—of helio- geo- stereo- chemo- thermo- rheo- and anemo-tropisms —but he does not mention our eutopotropism, because he is not strong on intelligence, perhaps?

Eutopia I spell with an E to distinguish it from the Utopia of Sir Thomas More and other visionaries. His Utopia was supposed to be the land where everything was well, and as there is no such place, the name was derived from the two Greek words οὐ, not, and τόπος, place. The word τόπος, which we have also in the word "topography," is also a root in eutopotropism. But the first syllable is from the Greek εὐ, well, which we have in numerous other English words, as "eugenic," well-born, "euphonic," well-sounding.

Thus eutopotropism is the sense or tendency to turn to the place for which the organism is well fitted, to which it is preadapted. This place may be—indeed, it certainly will be—less fitted to other organisms. It is not a general Utopia, but it is a logical next step to the theory of preadaptation, as developed by Cuenot and Davenport, to consider for what the organism is preadapted and what it will do.

They pointed out that when an individual varies from its forebears, it will often do so in a way that makes it better fit and more able to survive in some particular set of surroundings before it is in them. If it comes to be in that particular set of surroundings, it and those similarly varying will there thrive. But will they have sense enough to go there or to stay if they find themselves there?

I use the term sense, because, ordinarily speaking, we regard behavior that takes you where you are well off and to the place for which you are fit as sensible, and the opposite tendency to kick against the pricks and to butt your head against a stone wall as unintelligent, or senseless. Perhaps others may prefer a longer word. Do not miss the idea, whatever you prefer.

I have chosen this subject as of interest not merely to us as geologists but to all of us as individuals and as members of the body politic. For we were men before we were geologists, and as we are composed of cells, in whose harmonious and fit cooperation is our bodily health, so we are but unit cells in that greater organism of society called the United States of America. It is well that we should find our fit place in it and that the whole nation should find its fit place in the family of nations.

But, granted that the subject is one of interest and importance, why is it fitting that I should select it on this occasion, which perhaps is the greatest opportunity of my lifetime to reach a wide, an intelligent and an influential audience. What has geology to do with it? Let me explain how I came to select it.

I trust you have not honored me with this high office simply because I have lived long enough to have arrived at years of discretion, nor because you think I will not bore you with too long an address and think that I have learned that brevity is the soul of wit, but because you also think that I have contributed somewhat to the science to which we are devoted.

If I had some great epoch-making geological discovery of my own to announce, it would be well to throw the limelight of this brilliant occasion upon it.

But Osler has suggested that new ideas do not come after sixty, and others have put the date as early as thirty. Failing such a discovery, it is natural to look over one's life and see which work of value seems to have been least appreciated.

I remember my old teacher Shaler at about this time of year, the time of the January mark-down sales, said to me: "Lane, I find at the end of the year I have a job lot of hypotheses that I would sell very cheap!"

So toward the end of life it is natural to look over ideas to see which have been sold and which, though still unsold, you consider valuable—not cheap, but such as you would commend to the attention of a discriminating audience.

Six years ago I coined the word eutopotropism in the heat of a verbal talk to students.[3] Thirty years ago I discussed the early surroundings of life and their evolution and the way life has adapted itself to the change,[4] and before that I had discussed the importance of individual choice in evolution.[5]

Indeed, I might go farther back. It is well-nigh forty years since I first addressed this society on the rôle of the earth's originally absorbed gases.[6] In some respects the conception of the rôle of the earth's

[2] "Some Contacts of Geology and Religion," *Harvard Alumni Bulletin*, Feb. 26, 1925.

[3] *Harvard Alumni Bulletin*, Feb. 26, 1925.

[4] SCIENCE, Aug. 2, 1907, p. 129.

[5] SCIENCE, May 4, 1906, p. 702, and *Outlook*, Vol. 58, p. 479, 1898, "Of Pegs and Holes, Individuality in Evolution."

[6] *Bul. Geol. Soc. Am.*, Vol. 5, pp. 259–280, 1894.

originally absorbed gases there defended doesn't need to be brought up again. It is sold!

That volcanic magmas contain gases and yield waters which do not come from the surface of the earth is now generally accepted, though as late as 1905[7] my old teacher Shaler said of outbreaks of volcanoes:

> This action appears to be due to the inclosure of water in the stratified rocks at the time when they are laid down on the sea floor; this crevice water becomes heated as the rocks become deeply buried, and by the central heat is brought to an exploding strain.

This possible source of some volcanic activity, illustrated in the frontispiece of Lyell's geology, is now almost entirely ignored. The works of Day, Allen, Fenner, Shepherd, Zies and their coworkers of the Geophysical Laboratory have thrown much light on the magmatic gases.

It is, however, a fair question on which we need more light which I commend to your consideration. What does become of the connate waters or petroleum when a sandstone is converted to a quartzite or a clay to a schist?[8] In the process of compaction, where and when and how do they go?

The rôle of magmatic gases and of juvenile waters is so well understood and so widely accepted now that I will bore you only for a few moments by recounting the evidence on one particular line of activity before I take up my main and more interesting theme, which is their effect on life.

These gases have a rôle in the crystallization of igneous rocks affecting not only the coarseness of grain of the igneous rocks and the minerals of the igneous rocks, which form from a rock magma as candy from syrup, but also affecting a wet and dry differentiation.[9] Hornblende and micas replace pyroxene and olivine, and the feldspar formation is prolonged as the magma gets wetter, with a consequent shifting of the eutectic or cotectic troughs and of the chemical character of the residual magmas available for differentiation. Much has been learned since 1895, and the recent president of the Association of Petroleum Geologists, Sidney Powers, has helped me to contribute thereto.[10]

Yet any treatment of rock crystallization and differentiation that would satisfy me and the severe and competent critics that would be in this audience would need mathematics and figures and diagrams, if it is to go beyond some such simple statement as above made, or a statement that the hotter the initial temperature of an igneous rock and its county rock are, and the more the mineralizers, the less pronounced will be the marginal belt of finer grain, while the general effect of the retention of these mineralizer gases is very much as though the temperature of crystallization was shifted toward that of the county rock and away from that of the original molten rock.

I remember that Professor Lindgren has complimented me as a "reformed mathematician." I must not backslide. So I put aside another subject. Geologic time, for instance, has much interested me and it would not be unseemly that, on the one and only occasion when a member of this society rises to the dignity of an American Senator and can take all the time to talk that he wants, he should take time for his subject. But I have recently spoken on time[11] and against time by radio. Dr. A. Holmes will treat it in his forthcoming Lowell lectures. Knopf's Bulletin 80 of the National Research Council has just given a masterly treatment. Finally, I do not think that I can handle the forty odd methods of estimating geologic time that I have listed, in a fashion to suit me without many figures, some mathematics and several hours! Gladstone, they say, could make a budget interesting, but I am no Gladstone, and I put it aside.

Before we discuss the way life has been affected by and has met the changes produced by the progressive inorganic evolution which these escaping gases have caused, let us first consider what signs there are of such an evolution and reasons for believing in it.

Returning to this exudation of gases from the interior, I would ask: If there has been a continuous supply of gases from within added to the ocean of air and of water and also a precipitation from the ocean either directly or by deposits due to organic life, would it not be a very striking and remarkable balance if there had not been some change in the oceans of air and water and an inorganic evolution in the sediments formed in them as well?

The more active of these gases will be combined and largely precipitated. For instance, the carbon dioxide so common in volcanic gases will be the food of plants, and the chlorine and sulphate will combine with bases.

But the more inert nitrogen and the rare gases will accumulate. Therefore, we are not surprised to find that they form a large part of our atmosphere.

If we find signs of glaciation and a more rigorous climate in early times, one factor may be that there was less atmosphere then. A rise of 300 feet in the atmosphere means a drop in average temperature of something like a degree. Thus the climate in times past must have varied with the amount of atmosphere. Taking away three thousand feet of atmosphere might well bring on another ice age if it meant

[7] Shaler, "Man and the Earth," p. 170–171.
[8] *Bul. Geol. Soc. Am.*, Vol. 24, p. 704, 1913.
[9] "Wet and Dry Differentiation," Tufts College Studies, Vol. iii, No. 1, 1910, pp. 39–53.
[10] *Bul. A. I. M. E.*, No. 110, 1916, pp. 535–548.
[11] *Scientific American*, Feb., 1930; *Scientific Monthly*, Apr., 1931.

lowering the snow-line 3,000 feet. This may have counterbalanced any possible greater heat on the sun. The diameter of the sun was very likely greater and that would tend to equalize the temperature at different latitudes. The brightness or amount of heat would tend to equalize the temperature at different latitudes. The brightness or amount of heat per unit of its area is likely also to have varied. Possibly for the former reason, but very likely more from a different distribution of land and water, climatic zones seem not to have been as marked in the remote past as at present.

If the crust of the earth was ever hot enough to vaporize all the water in the ocean and the ocean was anything like its present ocean, the temperature at the base of this very heavy atmosphere might be far above 100° C. and near the critical temperature of water, 374°. The water would remain gas until cooled down to that temperature. Thereafter from that point the rock surface temperature would slowly drop, a process ignored by Lord Kelvin.

I do not, however, personally believe that the early ocean, either of water or air, had the volume of the present. If Foqué was right in estimating that one of Etna's minor parasitic cones emitted in 100 days 2,100,000 cubic meters of water, in 600 years it would discharge a cubic mile. Thus only a hundred such vents would suffice to discharge all the 300 million cubic miles of sea water in the 1,800 million years or so in which it seems likely we have had plenty of time to have discharged the ocean.

Of volcanic gases the vast bulk is water.[12] Some of the water gas might be absorbed in hydration of the rocks. But the crust of the earth, ever near enough to the surface to be hydrated, must be much less than 10 km[13] and much less than 5 per cent. by weight of the 10 km can be water. This would be about 2 per cent. by volume, so that the water absorbed in the crust must be less than 200 meters, no great addition to the volume in the ocean.[14] Most of the water exuded from the interior must be still in the ocean, whose volume is continually increased by volcanic emanations. I know no signs that the earth is absorbing the oceans or that they were once deeper than now—quite the contrary.

The next most abundant gas is carbon dioxide. This can be and is precipitated directly as calcium magnesium, ferrous and other carbonates. As soon as plants were available, it would be decomposed by them into vegetable fiber and oxygen.

To be sure, vegetable fiber may be eaten and oxygen breathed by animals and reunited. Yet insofar as we find carbonaceous matter of organic origin in the crust of the earth, petroleum, coal, peat, natural gas, etc., we may reasonably look for the oxygen which went with it, when the carbonaceous matter was reduced by plants from CO_2. Some of it goes into oxidation of the red rocks, as C. H. Smyth[15] has estimated. But this will not account for all. For the balance we may look to the amount of oxygen in the air, some four pounds per square inch, though, as we really know nothing as to how much carbon there is beneath the three quarters of the earth's crust covered by the oceans, an estimate might well be characterized as three hops of hypothesis, a skip of computation and a jump to a conclusion!

Nitrogen of the volcanic gases must also accumulate, mainly in the atmosphere, for the amount in the rocks and waters is much less than the carbon dioxide. Here again it may be possible to compute whether the nitrogen in the air is to the water of the ocean and the oxygen of the air as the analyses of volcanic gases would lead us to expect. The sulphur may be represented in the sulphates of the ocean, the anhydrite and gypsum of the land and in the widespread sulphides. The chlorine is partly represented in the salt domes and the salt water of the strata and the chlorine of the ocean. When first delivered, whether as HCl or Cl, it would naturally attack the bases in the order of their abundance and ease of attack. Calcium and iron chloride would be more abundant than sodium chlorides. But when it comes to precipitation, calcium, magnesium and iron are surely deposited from the ocean more than the sodium. It will be a rare drilled well in which there is not more lime than soda in the cuttings. Therefore, there will accumulate in the ocean an increasing proportion of sodium, while in the early ocean there was a relatively larger proportion of earthy chlorides.

While we can not say offhand that the ocean would be growing saltier, since that would depend on the relative supply of water or base exchanges, the precipitation effect of organisms and other factors, it seems almost certain that there has been an increase in the proportions of sodium to chlorine. Moreover, all lakes without outlets tend to grow saltier. Why should that great salt lake called the ocean be an exception? The very old and very salt waters that are sometimes encountered one would have to explain as the residue after the hydration of volcanic glass and the formation of chlorite.[16]

But all this is a deduction from the general idea of exudations from the interior. Are there any facts

[12] *Shepherd Bul.* Hawaiian Volcano Obs., viii, 5, 1920, p. 2, other papers of this observatory and various papers of the Geophysical Laboratory.

[13] Clarke, "Data of Geochemistry," *U. S. G. S. Bulletin*, 770, pp. 32, 34.

[14] M. L. Fuller and others cited in Clarke, *ibid.*, p. 35, make it perhaps 1 per cent. of the ocean.

[15] *Jour. Geol.*, 13, 1905, pp. 319–332.

[16] *Bul. A. A. Pet. Geol.* 11, 1927, p. 1283–1305.

substantiate this idea? I think that critical study analyses of waters, and other facts support it.

The question how we can distinguish between the aters circulating down into the rocks now or from st land surfaces, the connate waters originally laid wn in the rocks, and these juvenile waters which ve emanated from below from invasions of igneous agmas—has been on my mind. It might well be e subject of a course of lectures. But it involves detailed consideration of analyses of the waters. any of you perhaps, like myself, can not very well nderstand figures by hearing them. I have to see em to understand. Perhaps some of you hate gures, anyway. Moreover, there are men here who ve vastly more material at their disposal than I, ho will take it up and by careful study of water nalyses will be able to distinguish buried land surces which have been leached and filled with a water ite different from that which originally filled the ds. So I shall not go into the matter in detail on is occasion, though I should be glad to take it up ith them individually. I look to a time when, with ide-spread use of accurate analytic methods, we all find the rarer ingredients also significant, iodine erhaps rarer in the older rock. We might, in the ge of the surrounding strata, find a reason for the w iodine and prevalence of goiter around Lake uperior. The distribution of Sr may also be sigificant, and the concomitant gashed dolomites.

I expect to see old land surfaces and disconformiies recognized by the associated waters. I suspect at, as in the Red Coulée field of Canada,[17] they ill be marked by a lower concentration and an inrease in other acid ions relative to chlorine, and in odium as well. Perhaps also, as R. L. Ginter sugests, organisms coming in from these old land surces may be traced by their biochemical reactions.

Again, while I do not propose to bore you with detailed discussion, are there not signs that in the rliest rocks, the Keewatin, or "greenstone schists," as they used fitly to be called, we have a formation hich does differ significantly from the later rocks? here are less signs of contemporary oxidation. The bundant lava flows lack the reddened top of later vas. Sedimentary carbonaceous beds are rare or bsent. So seem to be red beds of any kind and red angue or flucan, or hematites that might be considred laterites.

We do not find beds of salt or gypsum or metamorphic equivalents of these in the Precambrian. I think the ferrous carbonates are more common in the Precambrian, which would be natural if this early atmosphere was not so oxidizing.

In this early period when there was little or no oxygen in the air, air-breathing animal life would be relatively absent. If we may carry over into geology the distinction made in college catalogues between biology and zoology, we might say that there was an early Azoic but not Abiotic Era. In the early Precambrian Keewatin rocks signs of animal life, at any rate, are rare.

I am convinced that the Precambrian limestones are akin to the so-called "shell marls" which my lamented friend, Charles A. Davis, studied for me[18] and showed were mainly the product of lime-depositing plants. We agreed that the same origin might apply to Precambrian.

It seems to me probable as a "hunch" that, while life began in a rather peculiar and individual environment, which the chemist and biologist after much experimenting have not yet been able to reproduce, it has gradually varied to fit varying environments and found a profit in new reactions, chemical and otherwise.

For instance, it seems as though in the later Precambrian, at a rather definite time in the earth's history, not the very beginning, the algae began to throw out lime carbonate, as the stoneworts (characeae) do now in our marl lakes. It was somewhat later that the organisms studied by E. C. Harder,[19] the iron-precipitating bacteria, learned to find a profit in the precipitation of iron oxides and initiated a world-wide age of iron deposits, and it was later yet before the conditions for them were so favorable that they abounded, as did the potato bugs about 1880, when I saw a windrow three inches high along high tide and as far as the eye could see along the Atlantic coast.

Still later, as Daly has pointed out,[20] came fishes, and a scavenger system was developed with a change in the quality of limestone. F. W. Clarke has also pointed out the effect of temperature in changing the proportions of lime and magnesia included in the shells of sandy animals.

As we have said, volcanic waters are generally acid and the ocean water is practically neutral. The rivers are high in sodium, lime, etc., combined with sulphate chlorine and CO_2 mainly, but a small amount of SiO_2. On reaching the ocean, the lime carbonate may largely be precipitated as limestone (directly or more likely indirectly), but the sodium carbonate or silicate may be thought of as converted into sodium chloride, while the silica is converted into the tests of the diatoms and the CO_2 is used by life in one way and another.

In the ocean the tendency to an increase of the ratio of sodium to chlorine was probably not uniform, for rainy climates and large land areas would furnish

[17] *Bul. Can. Mining Institute*, Nov., 1930.

[18] *Jour. Geol.*, 1900, Vol. 8, 1900, pp. 485–497.

[19] *U. S. Geological Survey*, Prof. Paper 113. See also Lane, *Geol. Mag.*, 1908, p. 485.

[20] *Bul. G. S. A.*, 20, 1909, pp. 153–170.

sodium more rapidly, while a large precipitation of salt would leave a residue in which the earthy chlorides were more abundant.

R. B. Newcombe tells me that a well at Muskegon, Michigan, 4,715 feet deep down to the St. Peter sandstone, has 59,785 of Na and K to 168,000 of Cl, a ratio of 0.353, while wells higher geologically (in the Devonian), but just as deep, have a higher ratio of Na to Cl. For instance, in a well near Midland, practically as deep down to the Sylvania sandstone just below the Devonian (4,697–4,700 feet), the ratio had risen to 0.4, and in the present ocean the ratio is 0.65.

In connate waters of the later Paleozoic, the ratio is usually from 0.44 to 0.53, as found by Reeves.[21] We must, however, remember that these and other buried waters struck by the oil wells have generally been more or less altered by diagenetic changes, by bacteria buried with them, or introduced later by circulation since burial of the strata, not by any means necessarily by circulation from the present surface, but by circulation from some ancient land surface which in leaching the limestone left it full of pores and caves and underground water channels[22] in which later petroleum could collect, ready to gush out when trapped. Such changes from old land surfaces in most cases seem to raise the proportion of sodium and of acid radicals other than chlorine, even though water is absorbed. For instance, the St. Peter's sandstone shows a fresh water 2,000 feet down. I have no doubt the normal oceanic Na : Cl ratio of St. Peter's time is less than 0.35 and nearer that of the Keweenawan, which seems to be near 0.08—the ratio of the time when hard parts and land animals may have developed, as we shall see.

But what about the life that has existed in this changing physical environment of the ocean?

While the single-celled forms multiplied in the water which brought them their food, those which showed they had a capacity to cooperate to help the circulation of sea water around through the mass had an advantage which led to the porifera or sponges which have a circulatory system which ultimately led to that of the blood of our veins.

Even though there was life even in the hot waters of the geysers, the chances are that somewhat cooler and somewhat less acid waters would on the whole be better for the activity of the protoplasm. While in the beginning there would be no limey shells in the acid or soft waters, and no tendency to produce them and if produced they would have been promptly dissolved, the time would come when the concentration passed the physiological optimum which doctors tell us is about eight parts per thousand. Then what? Some of the organisms would secrete some of the extra salts. If they were secreted internally, they might serve as a skeleton support. If they were secreted around the outside, they might serve as a shell-like protection. A leathery or shell-like protection might serve to protect from evaporation as well as attack. They could stand exposure to the air. Some of them might find themselves better off in streams where the water was somewhat too fresh, than in the ocean where the water became too salt. Others would find the reverse. So we find forms diverging, fitting themselves for different stations.

Thus we find in fresh-water forms various concentrations below, in salt water forms, concentrations above, and in land forms the concentrations just about eight parts per thousand.

While Quinton, who first emphasized these facts,[23] considered that concentration the original composition of the ocean, I maintained that it is more likely to be that of the ocean at the close of the Precambrian, *i.e.*, not 2,000 million years ago, but only some 500,000,000. We find the urge to secrete hard parts appears in the same geological period with a simultaneity in various lines of life that points to some changing factor in their common environment as the cause.

The Keweenawan, however, whether Cambrian, as I believe, or Precambian—the current work of Dr. Urry on the helium, radium, thorium ratio of its traps may have settled the question—was at any rate laid down under an oxidizing atmosphere, so that its red sandstones and weathered traps are much like those of later days. It is very different from the Keewatin, and the normal ratio of Na : Cl seems to be not far from this critical value.

When the ocean passed the physiological optimum, some forms were carried passively with it. Others, as has just been said, resisted by secreting shells, by development of a special circulatory fluid and by getting out on land. With the modification of environment came the command, "Modify to match, or migrate, or go to the morgue and mortify!" The annelids and the clam were fitted to stay in the mud, and they stayed. My ancestors "were fitted for higher things," and they migrated to find them.[24]

Various modifications fitted them for various stations in life. But the modification often came first,

[21] Yet he found for his Devonian brines the ratio, 0.355. Johns Hopkins University *Contributions to Geol.*, March, 1917, p. 65.

[22] See Howard, *Bul. Am. Ass. Pet. Geologists*, 12, Dec., 1918, p. 1153, and Newcombe, R. B., *Bul. G. S. A.*, 1931, p. 725.

[23] "L'eau de Mer Milieu Organique." *Cf.* "The Early Surroundings of Life," SCIENCE, August 2, 1907. "Isolation by Choice," SCIENCE, May 4, 1906, p. 702.

[24] See also H. Van Dyke's "Quatrain to a Recreant Clam."

as assured by the theory of preadaptation of Davenport and Cuénot.

If so, it is altogether likely that some organisms did not go to or find the place which they fitted.

Only those who had the sense to go to it or, if they were there accidentally, to stay in it would profit by their fitness and variation advantage! If their children inherited their variation and their sense, they would in turn profit by it. Thus a nerve reaction or variation, an intelligence correlative to the other variation was needed.

Some forms would be fitted for land life, could emerge from the sea with a circulation cut off from the sea yet retaining traces of its composition at the time they emerged, and a skin to prevent its evaporation too fast—just enough to keep them cool on hot days. In the new surroundings, which they alone fitted, they would find less competition. If they were eutopotropic, they would stay there and mate with others like-minded.

But once out on land, there is a wide variety of climate—from that of a tropical jungle or of a tropical desert to that of a Siberian desert or to that of the Antarctic continent. Yet almost everywhere we find forms of life, fitted so that they can survive and thrive in those surroundings. Sometimes they have to seek other surroundings to breed.

Now this we notice, that whether or no they fit into their surroundings, the higher life which is mobile does not have to stay there. Indeed, like the migrating bird, it often journeys far. Among the most wonderful journeys are those of the eels, from the center of the Atlantic to the fresh-water streams and back, and the salmon, from the fresh-water streams to the ocean and back.

In other words, with fitting the environment goes finding the environment that fits. Let us illustrate again.[25]

Before the Himalayas were nearly as high as at present, elephants roamed Asia. Some had less hair and were better fitted for the climate of India, others had more and were better fitted for the climate of Siberia. But there was nothing to prevent the hairy one going south. No doubt some did and got too hot and caught cold and died.

Little by little, however, there was a gradual segregation of the hairy to the north, the hairless to the south.

We will agree that there have been great changes of climate. Through these Nature commanded, "Modify or migrate." Some animals, preadapted, could obey the first alternative, others, sensibly eutopotropic, obeyed the second. Those without variability or intelligence perished.

[25] *Harvard Alumni Bulletin*, 1925, p. 649; *Tufts College Weekly*, Jan. 1910, p. 175–181.

This finding the place for which the organism is fit we call intelligence, or especially when it is hard for us to imagine that in the animal mind the movement is toward a clearly conscious goal, instinct. But in general, the higher animals seem to have instinct replaced more and more by conscious intelligence. Behavior which seems to be controlled by the future, by an aim or goal, we call intelligence, whereas action which we can predict from the past we call mechanical.

"Westward, the star of empire takes its way" describes in poetic language the spread of the race of man over the world after the last ice invasion. It is in part perhaps instinctive. It has culminated in my lifetime in the attainment of the North and South Poles, the battle of Manila, the entrance of Japan into the list of great powers, and the formation of the League of Nations after a world-wide war.

But the settlement of America was partly that of intelligent purpose. My Puritan forebears came with a definite aim, to construct a *commonwealth* (note the word "common") which should be nearer what they thought God wanted, a purer form of government in church and state.

Carl Schurz and the "Lateinsche Bauern" came to get a greater freedom and a more democratic government than then existed in their fatherland. Many before and since have come to America from many lands, the cream of their respective communities, because they were the more discontented and restless, who sought, like Abraham of old, a better land, or as the Pilgrim said, enlargement. These restless energetic souls, even though they may be classed themselves as dangerous radicals, may make fine sires. Many people who would think of Congressman Lindbergh as a dangerous radical would agree that he was a success as a parent, and that the United States stock would not have been improved by keeping him out.

My Uncle Daniel went from New England to Kansas in the days of bleeding Kansas. So his son enlisted in the days of the Spanish War and now finds himself in Honolulu.

In the development of the United States, in the pushing back of the frontier, in the development of the oil business, there has often been little conscious planning for the good of the whole, any more than there was in that wild stampede of individualists which opened the magnificent state of Oklahoma. It was partly "each for himself and the devil take the hindmost" and partly "there is plenty for all, help yourself. Uncle Sam can give every man a farm."

Twenty-odd years ago, called upon to speak at a banquet in Saginaw, about one o'clock in the morning, after a long evening of speeches, I told the Saginaw business men that when they ran out of other fuel,

they could strike gas! I also told them I hoped they would not strike it before they had changed the state law to prevent overdrilling. They found it where I said, but they had not changed the state law as much as it should be changed, and even since I started writing this, a horrible tragedy of burning, involving some of my friends, has occurred, and may be due partly to overcrowded wells. Overcrowding is emphasized in this year's *Michigan Engineer*.

But, as, when the ocean grew too salt, survival was for those who could find a fit place in new conditions, so it is now. Conditions in America have changed. Our early towns grew helter-skelter. Now we have city-planning boards and the eutopotropic man, if he fits that kind of thing, will seek a decent, a beautiful and a well-laid-out town. No doubt, too, there will be for a good while helltowns, and people who find themselves most at home there will turn that way.

The era of expansion of the human race approaches its close. The era of organization, of cooperation dawns. Not only in the petroleum business, but in world affairs, the question is who has enough sense, enough intelligence to find his place, the place where he fits, and our Nation fits, to find its place in these new conditions.

> The old order changeth, yielding place to new
> And God fulfils himself in many ways
> Lest one good custom should corrupt the world.

We have been absorbing the gold of the world. We have more than half of it. We were gathering in the rest at a rate that would surely corner it. This has not been deliberately and intelligently done, but the result has been one factor in business depression. As we cornered gold, the price of everything else measured in gold went down. If continued, sooner or later debts payable in gold can no longer be paid. Shall we have intelligence to see this and arrange for some way in which the debts due us from Europe shall be paid in some work for world welfare, but not in gold? Shall we have sense enough to fit the new conditions and learn from Him who said, "He that would be greatest among you, let him be the servant of all." Or shall we, buzzing some clichés of isolation and independence and separation of politics and economics, continue to butt our head against the wall, kick against the pricks and squeal when we are hurt?

Years ago I was geologizing down South, and one noon we unhitched the mules from the buckboard and left them to eat their rations of corn from its rear while we sought a cooler spot under the shade of a tree a little out of sight.

After a little the noontide stillness was pierced by a tremendous vociferousness, unquestionably arising from one of the razorbacks. I said to my driver:

"Alex, one of those mules must have kicked a hog."

"Hit sounds lak hit."

The noise continued in undiminished volume. The air quivered.

"It must have broken her leg. Let's go and see."

We went over. The hog had too much sense, was too eutopotropic to get near the business end of the mule, but in reaching through the spokes of the wheel, the spokes caught her by the nape of the neck. As soon as she felt caught, she braced and the more she braced, the tighter she was held. But her vocal powers were not checked at all. We sat and laughed for a while. Then Alex put his foot on her neck. One magnificent squeal and off she trotted, unhurt.

Many animals have no more sense than the hog or the moth with the candle. They will draw tight the cord that holds or chokes them.

When I suggest a tax of two cents a thousand on gas produced, whether used or not, will I not be greeted with squeals of remonstrance as vigorous as that which greeted Doheny's investigation plan? Yet there is that which withholdeth more than is meet, but it tendeth to poverty. Those who protest may be much benefited.

How much better are we?

As geologists we use the present as a key to the past. From past and present we should be more able than many to outline the trend of things. There is the present duty on us to advise and warn our business associates and fellow citizens as to what the experience of the past billion years teaches.

Have we sense enough to fit ourselves to the rôle of a credit nation? Being the richest nation on earth, have we sense enough to know that pride goeth before a fall, or have we sense enough to wisely use our wealth as trustees for the world, in stamping out disease, in preserving ocean life, in studying the climate of the world, in building the beacons of the air, in educating men of science? It would be selfish for this audience to suggest that Germany pay part of her debts by giving scholarships in the advanced work of the universities to 400 of the American geologists out of work, yet it would accomplish a threefold object—not only relieve unemployment, but help Germany's task of paying reparations and improve our geologic skill.

So I do not emphasize this, but I would urge that it is senseless as a nation to shut our eyes and content ourselves with saying, "They borrowed, let them pay," without considering how they are to pay.

I have wondered if the policy of counting every admixture of the white and black races as black, allowing free marriage between black and colored and checking marriage between colored and white (though not entirely preventing breeding) was intelligent and

would not inevitably and mathematically lead to a larger and larger preponderance of colored with more or less white blood; whether our attitude toward the Indians (which has led to persons like Mrs. Woodrow Wilson, Calvin Coolidge, Vice-President Curtis, and others) was wiser.

The American people are cramped by legislation and by a respect for tradition in the legal profession, which is not without advantage in retaining what is good from the past, and geologists are evolutionists rather than revolutionists. But it hinders greatly that adaptation to changing conditions which one finds in the frontiersmen.

It made it very hard to change the laws suited for the wet climate and rural conditions of England and the Emerald Isle regarding water rights so as to have a code suited to a land which is worthless without irrigation, or to handle the problems when great cities spend tens of millions and reach out tens of miles to remote watersheds crossing state lines for their water.

The great works of the present, like the Chicago drainage canal, affect men from Georgian Bay on the north side of Lake Huron to New Orleans. They are not state matters.

So again the flood of oil, due to the way in which you petroleum geologists have so successfully, too successfully, applied your science to the development of national resources, can not be handled by individual state action any more than can a Mississippi flood.

In these days of automobiles, to say nothing of airplanes, when in our smaller New England states a man can be in five states in an afternoon, is talk about throwing the control of the liquor traffic back into the hands of the states the buzzing of the June-bug?

Again, facing the problem of unemployment, modified as it is by the enormously increased powers of production, is it not necessary that some planning be done as to what and how much shall be produced? If some new invention puts whole communities out of business through no fault of their own, as the invention of rayon silk has crippled the making of cotton stockings, would it be too much to demand part of the invention royalties to rehabilitate and to teach those thrown out of work some new and useful work?

Should any one out of work be helped until he had been examined for the work to which he is preadapted? Possibly he may be out of work because he is no good at the job into which he drifted. Should a prerequisite for a dole be four hours a day of study?

All these are questions which require sound sense, a spirit proposed for progress, but guided by the experience of the past.

Fifty years ago Dr. Penrose and I were in Harvard together. Little did I dream that I should succeed him as president of the Geological Society of America, or that he would leave the society the magnificent endowment that will be a monument to his memory, more enduring than any erected in a cemetery. In the first place, there was no such society. In the second place, he was a freshman when I was a sophomore, and got his bachelor's degree a year later than I, though he received the degree of doctor of philosophy from Harvard two years before me, having the practically unique distinction of obtaining it at Harvard in two years after the A.B.

Now the large endowment brings to the Geological Society new conditions. Shall it be adaptable or eutopotropic? While I do not forget that word of our Saviour, "Where the carcass is there are the buzzards gathered together," I have faith to believe that we have sense enough to be eutopotropic, and will find in these larger conditions room for worthy expansion, that the new conditions may be to us as the expanding shell to Holmes' chambered nautilus:

> Build thee more stately mansions
> Oh, my soul,
> As the swift seasons roll.
> Let each new temple, nobler than the last,
> Shut thee from heaven with a dome more vast.

Environment, heredity—these are not all the factors in evolution. We must add our individuality as helmsman. Some of you have doubtless seen a yacht race. As a son of the Old Bay State, let me close with the following sonnet, dedicated, with his permission, to probably the most skilful helmsman in the United States, Charles Francis Adams—a sonnet which gives a picture of the three factors in evolution. Besides heredity and environment we have individuality—eutopotropism—sense enough to steer a skilful course, sense enough to find the fastest track.

THE RACE

Oh, see the sloops with sails that flash out bright
  Against the ruffled sea and grayer sky
Along the horizon, when the waning light
  Strikes fairly on the mainsails towering high.
They vanish as they come about to tack—
  First one and then another, as for each
The helmsman picks her individual track,
  Knowing his own boat's sails and lines and reach.
So, studying wind and wave and rip and tide,
  Toward the desired haven they beat in.
Be breeze adverse or light, yet on they glide,
  The skipper's wit counts much the race to win.
Our forebears give the boat, but we must steer
  Across life's seas, though weather foul or clear.

OBITUARY

GEORGE EASTMAN

THE press and the public seemed instinctively to realize that Mr. Eastman's last message "My work is done; why wait?" and his dramatic termination of his career formed a fitting end to a remarkably consistent life. Certainly it is true that his close friends and associates view this ending as the final triumph of a man who all through life made his own way, made his own decisions and courageously followed the line of his convictions. Consider for a moment the full significance of his last words. He had invented the modern photographic plate; he had invented the photographic film; he had made the kodak a household object throughout the entire world; he had created a great business; he had established a great research laboratory which had strikingly fulfilled his faith in it; he had selected certain fields of education, health and art to which he had devoted his fortune for the benefit of the entire world; he had satisfied his instinctive desires for the excitement of exploration and big game hunting; he had no close relatives; the infirmities of old age had come upon him and were about to master him. He who had always been his own master remained so to the last.

George Eastman was born in Waterville, Oneida County, New York, on July 12, 1854, and lived there until he was six years of age, when his parents, Mr. and Mrs. George W. Eastman, went to Rochester, New York, to live, where in 1842 his father had founded Eastman's Commercial College. The father died two years later, leaving Mrs. Eastman without funds and with the eight-year old boy. By dint of hard work and self-denial Mrs. Eastman kept the boy in school until he was 14, when he became an office boy for Cornelius Waydell, a Rochester insurance agent. He stayed with the firm two years and then went with Buell and Brewster, afterwards Buell and Hayden, insurance agents. He studied at home in the evenings and later became a bookkeeper in the Rochester Savings Bank. It was while he was employed there that he began in his leisure hours experimenting with those photographic developments which were the foundation on which was built the Eastman Kodak Company.

In the very beginning period of Mr. Eastman's experiments, there were boarding with his mother a Colonel and Mrs. Henry A. Strong. Mr. Strong was a well-to-do partner in a whip manufacturing firm. He became interested in Eastman's experiments and his careful calculation as to what might lie ahead in the photographic industry, and in 1881 he made an investment of $1,000 in Mr. Eastman's business, following it shortly afterward with an additional $5,000. For some years Mr. Eastman and Colonel Strong were business associates and together went through some of the early trials and tribulations of the business, for the story of the growth of the Eastman Kodak Company was not without its trials and tribulations, as the following illustration will show.

Late in 1881 or early in the following year, the output of the Eastman plant had risen to about $4,000 worth of plates a month, all of which were shipped to wholesalers, who allowed the unsold plates to accumulate throughout the winter. Suddenly it was found that the Eastman plates had lost their sensitiveness, and complaints began to pour in on the young manufacturer. At great cost he called in and replaced all the defective plates.

Shortly after this episode another calamity came upon the company, for the art of making plates seemed to have been lost. The plates fogged easily and lacked sensitivity. During this period Mr. Eastman slept in the laboratory and carried out 469 experiments, all of them failures, in an endeavor to locate the cause of the trouble. During this time he became so nervous that he could not sleep, and lay awake at night reading cowboy and detective stories in order to rest his mind. Finally, after having been carried into debt, it was discovered that the difficulty was due to a defect in some of the constituents which had been purchased in a large order. Thereafter Mr. Eastman always made careful experiments in order to test new lots of material ordered for his film.

An eager and active research man himself, Mr. Eastman was always on the lookout for new ideas or developments from other sources, and gradually added to his staff young men from all over the United States and England who had shown the ability to contribute new ideas and developments to the photographic art. In this connection, he established his research laboratory, and his vision is shown by the fact that he stated that he did not expect results from it for ten years. His faith, however, has been amply justified by the development of new photographic products. In fact, only a few months ago Mr. Eastman expressed to the director of his research laboratory, Dr. Mees, his feeling of satisfaction in the fundamental strength of the company. He said that never before had such a fine lot of new products been put out and never before had the organization of the company been in so satisfactory a condition. He felt that the future success of the company was assured.

In the recent biography of George Eastman by Carl Ackerman it is stated that by the winter of 1879–1880 Mr. Eastman had established four fundamental business principles upon which he was to build his own

company. First, production in large quantities by machinery; second, low prices to increase the usefulness of his products; third, foreign as well as domestic distribution; fourth, extensive advertising as well as selling by demonstration. It was fundamental in his business policy that service should be given to the public. This is illustrated in the watchword in the early days of the kodak: "You press the button; we do the rest." It is illustrated now by the service on film and by the sale of kodaks which, after all, are simply a service and a means to increase the film industry since it is the film and plate industry which is, and always has been, the backbone of the business.

Mr. Eastman has been one of the world's greatest philanthropists. His benefactions during his lifetime exceeded $100,000,000, with $12,500,000 more added in his will. His first contribution to education was made in 1887 when he sent fifty dollars to the Mechanics Institute in Rochester. It was a modest sum, but it was the genesis of his giving. His salary as treasurer of the company was at that time under sixty dollars a week. Even at this early period in his career, he had strong convictions in regard to the relationship of the individual to the community.

By far the largest of Mr. Eastman's contributions have been to the Massachusetts Institute of Technology and to the University of Rochester. He also made important contributions to the Tuskegee and Hampton Institutes for education of the Negroes. He felt a pride in, and a responsibility for, the city of Rochester, and made notable contributions for the benefit of that community, chief of which are the Eastman School of Music and contributions to the medical center of the University of Rochester and the dental clinic. In recent years he had also established dental clinics in several foreign countries. It is said that his interest in so doing was due in part to his desire to make some contribution for the benefit of people in those countries in which the business of the Eastman Kodak Company had prospered in its foreign contacts.

It is very certain that Mr. Eastman's philanthropies were never the result of emotionalism or sudden fancy. They were carefully thought out and calculated. They were generally preceded by a long study of the situation on his part before the recipient had any idea of what was in his mind. They generally came not as the result of a request to Mr. Eastman for assistance, but as the result of Mr. Eastman's own independent study of situations in which he felt that his wealth would be of benefit to the public.

In his first interview with Mr. Eastman thirty years ago, President Rush Rhees, of the University of Rochester, was told by Mr. Eastman: "You know, Mr. Rhees, I am not interested in higher education." At least a part of the story of what caused Mr. Eastman to change his mind on this point and to become one of the greatest of all benefactors of higher education is given in the history of his growing interest in the Massachusetts Institute of Technology.

In 1891 Mr. Eastman asked Professor Thomas M. Drown, of the Massachusetts Institute of Technology, to "select a young chemist from the graduating class who can devote some attention from now until graduation to photographic chemistry. I do not want anyone who is not painstaking, thorough and thoroughly reliable. Harum-scarum youths are not of any account in this business. I have a great deal of confidence in the material you turn out of your institution."

During the next few years Eastman engaged several graduates of the Massachusetts Institute of Technology and his enthusiasm for this "material" increased to such an extent that he began to read the annual reports of President Richard C. Maclaurin and to study that system of technical education. He continued for nearly twenty years to observe the value of technically trained men and posted himself in the history of this institution.

Finally, in 1912, Mr. Eastman expressed a desire to meet the president of the institute, and a meeting was arranged at the Hotel Belmont in New York City. As a result of that meeting Mr. Eastman wrote to the president that he was prepared to give the institute as a building fund the sum of two and one half million dollars, asking that his gift be anonymous, as he wished to avoid all fuss, his one object being to see a good thing done and not to hear people talk about it. In referring to his interview with Mr. Eastman in New York, Dr. Maclaurin wrote: "I could not fail to be impressed with his capacity to go to the heart of a problem quickly and to see immediately what the main points were and to keep to them in later discussions—an impression increased by later intercourse." Later, in 1913, Mr. Eastman increased his subscription to the building fund by five hundred thousand dollars, making his total initial gift three milllion dollars.

For eight years after the initial gift, the name of the donor remained simply "The Mysterious Mr. Smith," and it is possible that it would never have been divulged had not a later gift in 1919, which necessitated the transfer of a large amount of his own Eastman Kodak Company stock, made it inevitable that his connection with the gift would be discovered. Particularly throughout the construction and equipment period of the new technology, but also clear up to the end, Mr. Eastman maintained his very keen interest in the progress of the institution. Yet with all this interest, so far as I know, Mr. Eastman has never visited the institute, except on two or possibly three

occasions, and on those occasions he came unrecognized and left unknown except for the president and a very few of his associates. We have here a truly remarkable record. First, a study of the record and work of the M. I. T. for a period of twenty years, then a period of continued contributions to the institute amounting to more than twenty million dollars over a second twenty-year period, and yet during all this time only two or three brief and almost secret visits to the object of his benefactions. And yet this does not mean that he did not pay close attention to the progress of the institution. His letters to President Maclaurin are ample evidence of his very keen insight and sympathy with the educational problem. In my own single visit to Mr. Eastman about a year ago, I was astonished by his keen questions in regard to certain of the funds of the institute and their present utilization.

Mr. Eastman's last gift to the institute was his contribution to the Technology Student Loan Fund. Until last year he had consistently refused to allow his name to appear on the great buildings which his gifts have made possible. The corporation of the institute voted that in recognition of his generosity, the great court about which the main building is built should be designated as Eastman Court. Within the past year Mr. Eastman consented to allow his name to be placed upon the new Physics-Chemistry Research Laboratories, which are therefore to be known as the "George Eastman Research Laboratories."

At various times Mr. Eastman indicated his reasons for giving so generously to the Massachusetts Institute of Technology. To a *Post* reporter he gave the following explanation: "Because Technology has two of the elements necessary for a great educational institution. First, its faculty, and second, the body of students. It lacked only the third great need of a successful educational institution—money. The same money might have been spent to start another school elsewhere, but such a school would lack these necessary elements—faculty and students; and a new school even with money might never have been able to supply them as Technology was and is. For many years I had been coming in contact with men from Technology, many of them right in my own employ here in this company. I'd been watching the progress of Technology for some time—I like to study things—and my special interest in Technology was due, no doubt, to the fact that I was constantly coming in contact with the men who had come from there. I had been watching the treasurer's reports from Tech, too, and so when I came to the conclusion that it was time to help Technology, I asked for an interview with President Maclaurin."

Of the various reasons given by Mr. Eastman for his gift to Technology, three stand out in special prominence:

(1) His appreciation of the needs of technical education of the highest type. He had seen this in his own business and observed it in others and believed that this need would be far greater in the future than in the past.

(2) His belief in the value of scientific training for executives. He knew, of course, that a good executive, like a good poet, is born and not made, but he believed that his training can contribute largely to his effectiveness, and his experience with men that he had employed demonstrated to him that men with a scientific training, and of course the right qualities of temperament and character, make first-class executives.

(3) His recognition of the duty of a man whose business is national to support national institutions and not only local ones.

President Rush Rhees, of the University of Rochester, to which Mr. Eastman's gifts exceed even those to the Massachusetts Institute of Technology, has kindly given me his estimate of outstanding characteristics of Mr. Eastman's philanthropy, based upon close personal relations with Mr. Eastman for a period of more than thirty years. The following paragraphs are quoted from President Rhees's letter:

"The first outstanding characteristic feature of Mr. Eastman's philanthropy, in my opinion, was his accessibility. I believe that beyond any other generous man of wealth, he saw every appeal that came to his office. He maintained no barrier of subordinates through whom alone he could be reached. By this I do not mean that you could walk up to his office and go in. Of course his secretaries protected him, and written appeals would very frequently be routed speedily to a scrap basket, but I believe that all appeals came under his eyes.

"The second characteristic that has impressed me was his independence in reaching decisions on philanthropic projects. Here in Rochester it has for many years been a commonplace remark that if he said with reference to any proposal 'I am not interested,' then that answer was final, nine times out of ten. His independence of mind showed itself, however, in the tenth case, in which, having studied the matter further, he changed his mind, and having changed his mind, would be likely to act with extraordinary broadness of vision. In my first interview with Mr. Eastman, thirty years ago, the remark with which he opened the conversation was 'You know, Mr. Rhees, I am not interested in higher education.' Tech, as well as Rochester, has had very convincing evidence

that in that particular he changed his mind, and also, having changed his mind, he proceeded to think of higher education on a scale that fairly astounded its advocates.

"I had another experience of the same sort in 1919 after he had made his initial gift for the School of Music. At that time we undertook to raise a fund of one million dollars to enable us to cancel deficits accumulated during the war period. I went to Mr. Eastman, among others. His first reaction, as firm as it was courteous, was 'I don't expect to give any more money to the University of Rochester.' To which I replied, 'I do not blame you at all; you have done marvelously as it is.' Then we talked over the problem a little further, and he answered, 'Of course I'll chip in,' and gave me one hundred thousand dollars.

"Third: I have referred to the broad scope of his conception of institutions in which he was interested. I remember his telling me with a great deal of pride, on that occasion when he remarked that he did not expect to give Rochester another dollar, that he regarded the Institute of Technology as the greatest educational institution in the world. You know better than anyone else how much he had then done and has since done to insure the realization of that conception.

"Fourth: When he made his great distribution of property in 1924 to you, Hampton, Tuskegee, and to us, I remarked to Mr. Hart, who was in Rochester for the execution of the agreement, 'Did you ever know anyone who "bunched his hits" like Mr. Eastman?' and Hart agreed that he never had.

"This might constitute a fourth characteristic. He did distribute his philanthropies widely, particularly here in Rochester. But he apparently preferred to concentrate his larger interests in a very few places. Relatively speaking, his gifts to Hampton and Tuskegee were phenomenal. I believe that they were due to the confidence inspired in him by Booker Washington, to which confidence Moton succeeded on Washington's death.

"In explaining his very large allocation of the 1924 funds to the University of Rochester, he expressed the conviction that Rochester was all set to become one of the best, though not necessarily one of the largest, universities in the country.

"Fifth: If you have read Ackerman's life of Eastman you must have been impressed with the very early conception of his business enterprise in international terms. I think that he carried over that natural attitude of mind in determining his chief gifts for education.

"Sixth: I would like to supplement what I said above concerning his independence in forming his own decisions by confessing that I take unalloyed delight in a statement which Mr. Eastman made, after the 1924 distribution of his wealth, to a reporter who was interviewing him and asking why he did so much for the University of Rochester. His answer was, 'Mr. Rhees never asked me for a dollar!' I cherish this with delight, because it is not strictly true. I did ask him for money at that first interview when he told me he was not interested in higher education. I also asked him for help at that later time when he told me he never expected to give any more money for Rochester. But these are the only two occasions. The first resulted in a gift of seventy-five thousand dollars; the second, as I have stated, in a gift of one hundred thousand dollars. But, to paraphrase the words of the parable, What are these among so many other millions which have come to our hands?"

Mr. Eastman's feeling of pleasure and satisfaction over his philanthropies is indicated by the following sentence from a letter in which he refers to another educational benefactor: "I think that both he and I have good reason to feel that the money we distributed will produce more important results than if spent in almost any other way."

Mr. Eastman lived quietly alone in the big house on East Avenue, just outside the city proper. It is interesting and pleasant to know, in recalling the self-denials and hardships of his mother during the early years of her son's life, that she also resided in his beautiful home before her death. In fact, he built and furnished the house as a home for his mother. Since 1905 most of his activities radiated from there. Throughout the house are paintings by Millet, Winslow Homer, Corot and others, and for many years his home was open to musicians, artists and sportsmen. In the museum on the third floor are his trophies from Africa, Alaska and other sections. In the spacious conservatory palms and flowers in endless profusion give color and variety to the scene. Here his guests listened to the organ and other music that he provided for the entertainment of his friends, while good-naturedly professing to be a "musical moron." Here his body lay in state preceding the final funeral services.

His death came on March 14, 1932, in the East Avenue mansion. He died as he had lived—thoughtfully, purposefully and with careful attention to details. The world will always hold his memory in warm and admiring regard, and continue to honor the name of George Eastman.

KARL T. COMPTON,
President
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SCIENTIFIC EVENTS

THE COPYRIGHT BILL

THE Copyright Bill introduced in the Senate by Senator Hebert, of Rhode Island (S. 176) is substantially the same as the Vestal Bill of 1930–31, which was passed by the House at the last session and was being considered by the Senate in the closing days of the session.

The Copyright Bill favorably reported by the House Committee on Patents April 5, and referred to the Committee of the Whole House on the state of the Union, was introduced on March 10, 1932, as H. R. 10364 and later in amended form as H. R. 10740 and H. R. 10976, by Representative William I. Sirovich, of New York, who, with the shift in control of the House, succeeded the late Mr. Vestal as chairman of the Committee on Patents.

Of the two the House Bill is the better bill. It was drawn from the standpoint of author and artist rather than from that of book and music publisher and distributor; is simpler, more direct, and a better piece of draftsmanship. It makes no reference to the International Copyright Union, but the adoption of the bill would, in the opinion of the State Department, clear the way for ratification of the Rome Convention by the United States, if the Senate were favorable to such action.

It outlaws piracy, recognizes property right as dating automatically from creation of the work or from first public presentation, does not make registration compulsory but encourages registration by restricting the damages that can be secured for infringement of copyright if the work has not been registered; gives the author the right to sell different aspects of his copyright to different parties so that he can dispose separately of publishing rights, dramatic rights, motion picture rights, radio and television rights, etc. The term of copyright is named as fifty-six years from the date of first public presentation.

American authors are still required to have their works printed in America as a condition of copyright.

The bill still favors the corporation over the individual in the vague and doubtful provision that "in the absence of agreement to the contrary where any copyrightable work is created by an employee within the scope of his employment, his employer shall be considered as the author of the work." Whether the writing of a book on physics by a university professor of physics would be "within the scope of his employment" would be for the courts to determine.

The greatest defect in the bill is a provision inherited from preceding bills known as the "book prohibition clause," which in the present bill is camouflaged under a section entitled "Impounding." In the effort to put the purchasing power of the American market into copper-riveted marketable form, so that it can be the subject of contract between American publishers and English authors or publishers, and under the mistaken assumption that additional opportunity for labor is thereby provided for the American workman, the bill prohibits the individual American citizen from ordering a single copy, for his own use and not for sale, direct from London or Edinburgh, Toronto or Sydney, of a book published in English by an author in his own country (even though the American citizen is willing to pay at his own costs the duty imposed on such importation by his own laws), if an American publisher has secured the right to publish an American edition when he is ready to do so, under penalty of impounding at port of entry and eventual confiscation.

As a result of the continued opposition to this provision the grudging concession has been granted that the citizen may exercise his right, provided he has first made application to the holder of the right of American reprint and the American publisher declines, or in ten days fails to signify his willingness, to procure the desired book for the citizen at a time not specified, with no penalty for delay, at a price equivalent to the foreign retail price plus transportation charges and customs duties.

Not 10 per cent. of books in English published abroad are reprinted in this country. The number of individuals who buy books without seeing them and without solicitation, on their own initiative, is relatively small. Yet to put a stop to this negligible trickle of foreign trade which might still flow over tariff walls, it is proposed to destroy a fundamental liberty of the citizen to trade in the markets of the world, so far as reprinted English books are concerned, a restriction on individual liberty for which there is no parallel in the legislation of any country; and for the negligible and doubtful good, thereby to be attained, to subject all legitimate foreign book trade to intolerable red tape and delay. The representative of the Publishers' Association at the public hearing stubbornly opposed the proposal to give the individual scholar the same right that has been finally conceded to libraries and to the United States Government itself, in the case of books for its own use, and the author of the bill at the public hearing, upon conclusion of the reading of a memorandum by Dr. M. Llewellyn Raney against the provision, submitted in writing on behalf of the American Association for the Advancement of Science, made the statement that the

provision must remain in the bill because the American Federation of Labor demanded it.

JOHN H. MACCRACKEN
AMERICAN COUNCIL ON EDUCATION,
WASHINGTON, D. C.

PROGRESS IN RESEARCH AT MELLON INSTITUTE DURING 1931–32

ACCORDING to the *Nineteenth Annual Report* of the director, Dr. E. R. Weidlein, to the trustees of Mellon Institute of Industrial Research, Pittsburgh, the sum of $722,541 was received by the institution from industrial fellowship donors during the fiscal year ended February 29, 1932. The total amount of money appropriated by donors to the institute for the past 21 years was $8,277,018, all of which was expended in defraying the cost of scientific investigations conducted for these companies and associations. Throughout the year covered by the report, 75 industrial fellowships, employing 176 investigators and engineers, were in operation. At the close of the year 58 fellowships were active, and of these 28 have been at work for 5 years or longer and 13 have concluded more than 10 years of research.

In reviewing the progress that has been made since 1911, when the industrial fellowship system was established at the University of Pittsburgh, Dr. Weidlein points out that the Mellon Institute has had fellowships on 230 distinct subjects, on which 775 scientists and engineers have been engaged. In all, during the period 1911–1932, 313 fellows and 357 fellowship assistants of the institute have completed their services to science and technology in the institution and have entered the fields of industry and education. As trained additions to the forces of manufacturing and teaching, these men, Dr. Weidlein says, constitute the institute's greatest contribution to humanity.

The fellowship achievements of 1931–32 are summarized in the report, special attention being given to the research advances made by the Air Pollution Investigation, the Multiple Fellowship on By-Product Coke, the Iodine Investigation, the Organic Synthesis Fellowship, the Petroleum Production Fellowship, the Protected Metals Fellowship, the Steel Fellowship, the Sugar Investigation and the Fur Fellowship. The activities of the institute's department of research in pure chemistry are also described.

During the calendar year 1931, members of the institute made the following additions to the literature: 2 books, 4 bulletins, 39 research reports and 33 other papers. Twenty-two U. S. patents and 33 foreign patents were issued to fellows. Lists of publications, 1911–1932, and copies of Dr. Weidlein's report for 1931–32 will be sent free of charge to laboratory directors, librarians and science teachers upon request.

The constructional work on the institute's new building is said to be proceeding satisfactorily; it is thought that this edifice will be completed and ready for occupancy in the summer of 1933.

PRINCETON CHAPTER OF SIGMA XI

THE sixtieth Chapter of Sigma Xi was installed at Princeton on March 19, 1932, and includes faculty members and students of Princeton University and staff members of the Princeton branch of the Rockefeller Institute for Medical Research. Dr. L. B. Wilson, national president, and Professor Edward Ellery, national secretary, were present to conduct the ceremonies. The installation took place in the historic faculty room in Nassau Hall, after which followed a banquet in Procter Hall of the Graduate College.

Twenty-six members of the faculty were initiated to full membership. Fourteen others were elected to membership, but were absent at the time of the initiation. Forty-two Sigma Xi members from other chapters, who are now on the Princeton faculty, affiliated themselves as charter members of the new chapter.

The officers elected for the first year were:

President	G. H. Shull
Vice-President	E. N. Harvey
Secretary	Paul MacClintock
Treasurer	E. R. Caley
Committeeman, 3 years	A. M. Greene, Jr.
Committeeman, 2 years	R. W. Glaser
Committeeman, 1 year	A. F. Buddington

The presidential address by Dr. L. B. Wilson was "The Cultural Implications of Research in the Sciences."

Eight visiting delegates were present as follows:

Chapter	*Delegate*
Brown	Leonard Carmichael
Columbia	J. W. Barker
Lehigh	Gilbert Doane
New York University	H. Austin Taylor
Pennsylvania	Charles W. Burr
Rutgers	M. A. Chrysler
Swarthmore	Edward H. Cox
Yale	L. L. Woodruff

THE OHIO ACADEMY OF SCIENCE

THE Ohio Academy of Science will hold its forty-second annual meeting at the Ohio Wesleyan University, Delaware, on April 28, 29 and 30, under the presidency of Dr. Alpheus W. Smith, of the Ohio State University. The program of the meeting, as now being formed, will follow in a general way those of other years, which is to say, a short business session of the academy will be held early Friday morning followed by a general scientific session to be ad-

dressed by distinguished scientists on topics of general interest; the afternoon will be devoted to sectional meetings, seven in all; and Friday evening will be given over to the annual dinner following which the presidential address will be given and possibly other interesting features, including a social acquaintance hour. Saturday will be devoted mainly to an adjourned business session and the completion of the sectional programs and for such diversions, social and otherwise, as may be provided by the local committee, including a trip to the famous Perkins Observatory.

The preparation of the sectional programs is in the hands of the several vice-presidents, as follows:

Zoology, Dwight M. DeLong, the Ohio State University, Columbus.

Botany, Arthur T. Evans, Miami University, Oxford.

Geology, E. M. Spieker, the Ohio State University, Columbus.

Medical Sciences, Shiro Tashiro, University of Cincinnati, Cincinnati.

Psychology, Horace B. English, the Ohio State University, Columbus.

Physical Sciences, Forrest B. Tucker, Oberlin College, Oberlin.

Geography, Eugene Van Cleef, the Ohio State University, Columbus.

It is worthy of note that the last mentioned section, "Geography," is a new section and meeting for the first time with the academy. As the "baby" of the academy it is attracting considerable attention to itself!

The early arrivals on Thursday will find ample provision for their comfort and pleasure in the way of excursions about the city in the afternoon and possibly an informal talk or lecture by some well-known member of the academy or invited guests, followed by a social hour.

The local arrangements are in the hands of the following committee: Claude E. O'Neal, *chairman*, Allen C. Conger, Philip C. Edwards, C. W. Jarvis, Edward L. Rice, William E. Riecken, Lorin A. Thompson, Don B. Watkins and Louis G. Westgate.

WILLIAM H. ALEXANDER
Secretary

SOCIETIES AND SECTIONS MEETING AT THE SYRACUSE MEETING OF THE AMERICAN ASSOCIATION

PLANS are rapidly shaping together for the sectional meetings and those of associated societies for the summer meeting of the American Association for the Advancement of Science to be held in Syracuse from June 20 to 25.

Thus far seventeen organizations have signified their intention of cooperating to make this meeting a successful one. Section A (Mathematics) has plans for at least two sessions. It is expected that each invited speaker will have an hour for discussion on a selected topic. Professor W. A. Hurwitz, of Cornell, and Professor H. N. Gehman, of Buffalo, have accepted invitations to speak.

The American Chemical Society will hold a regional meeting in connection with Section C. A symposium on "The Effect of X-Rays on Biological Life" is planned for Friday morning, June 24. Members of Section B (Physics), Section F (Zoological Sciences) and Section N (Medical Sciences) will undoubtedly participate in this symposium. Friday afternoon and Saturday morning will be devoted to selected papers. The papers on Saturday morning probably will be of greater interest to industrial chemists.

Section E (Geology and Geography) is planning several interesting field trips. It is expected that competent guides will lead these trips and deliver short talks at points of geological interest. The Ecological Society of America will meet with Section F (Zoological Sciences). The zoologists expect to hold programs on Tuesday, Wednesday and Thursday. Several field trips are planned. The section of New York around Syracuse offers exceptional facilities for excursions and field trips for zoologists, botanists and geologists.

Several societies are lending their support to Section G (Botanical Sciences) and their field trips with round table discussions promise to be most interesting. Leaders have been selected for each field trip. Each of these is now busily engaged in working up the discussion material for his meeting. Among the societies and organizations which have thus far promised cooperation in making this an exceptional summer meeting for Section G are: The Botanical Society of America, American Fern Society, Torrey Botanical Club, Syracuse Botanical Club, Geneva Experiment Station, Brooklyn Botanical Garden and the Botanical Department of the New York State College of Agriculture at Cornell.

The psychologists of upper New York will meet with Section I (Psychology) for a two-day program. One symposium will be devoted to industrial psychology and another to mental hygiene. Professor Edward Lee Thorndike will give one of the association's general evening lectures.

Plans have been made for holding at least two symposia in connection with Section K (Social and Economic Sciences); one on "Statistics in Relation to Social Science." The title for the second symposium has not been announced as yet. An excursion to the statistical laboratory of Professor F. A. Pearson and Professor G. F. Warren at Cornell will be a feature of the meeting. The affiliated Econometric Society, an international society for the advancement of economic

theory in its relation to statistics and mathematics, will organize at least two symposia. The president, Professor Irving Fisher, will lead a symposium on "Money" and will present a paper. A symposium on "Demand" is also being organized.

Although no affiliated or associated societies are meeting with Section M (Engineering), the section plans two very interesting symposia; one on "Industrial Engineering" and the other on "Aerial Photography."

Every effort is being expended to make the Section N program one of the strongest in years. Several organizations are planning programs either of their own or with Section N. Among those meeting with the section are the Society for Experimental Biology and Medicine (Western New York Branch), Radiological Society of America, the American Society of Bacteriologists (Central New York Branch), Onondaga County Medical Society and the Syracuse Academy of Medicine.

The northeastern section of the American Society of Agronomy is meeting for two days, one at Geneva and one at Cornell. This, in connection with the symposium on "Land Use" to be held at Syracuse will make a very attractive program for Section O (Agriculture).

Several symposia are under way for Section Q (Education). Definite announcements will be made regarding further activities of these sections in the immediate future.

Charles F. Roos,
Permanent Secretary

SCIENTIFIC NOTES AND NEWS

The sixty-eighth annual meeting of the National Academy of Sciences will be held in Washington on April 25, 26 and 27, 1932.

The general meeting of the American Philosophical Society, Philadelphia, will be held on April 21, 22 and 23.

The president of the fourteenth International Congress of Physiology writes that no change has taken place regarding the date fixed for the congress: August 29 to September 3, 1932, in Rome. In the near future members who have already completed and returned their registration cards will receive a second circular giving the latest information regarding the congress, membership card, reduced rate rail tickets and program.

Dr. Benjamin Kendall Emerson, for forty-seven years professor of geology at Amherst College, died on April 7 at the age of eighty-eight years. Dr. Emerson became professor emeritus in 1917.

Dr. Wilhelm Ostwald, long professor of physical chemistry at Leipzig, died on April 4, at the age of seventy-eight years.

At the special convocation of the University of Durham in June next the degree of D.C.L. will be conferred on Sir Frederick Gowland Hopkins, professor of biochemistry in the University of Cambridge and president of the Royal Society.

Dr. William H. Welch celebrated his eighty-second birthday on April 8.

Dr. Waldemar Lindgren, professor of geology in the Massachusetts Institute of Technology, was recently elected a foreign corresponding member of the Royal Swedish Academy of Sciences and of the Swedish Academy of Engineering Sciences, both of Stockholm.

Dr. Phoebus A. Levene, of the Rockefeller Institute for Medical Research, New York, has been elected a corresponding member of the Bavarian Academy of Sciences.

Dr. Alfred F. Hess, professor of clinical pediatrics in the University and Bellevue Hospital Medical College, New York, has been elected a member of the "Deutsche Akademie der Naturforscher."

The medal of honor for 1932 of the Institute of Radio Engineers, at its twentieth anniversary convention in Pittsburgh, was presented on April 8 to Past-president Arthur E. Kennelly, professor emeritus of electrical engineering of Harvard University and the Massachusetts Institute of Technology. The citation states that the medal is awarded to Dr. Kennelly "for his studies of radio propagation phenomena and his contributions to the theory and measurement methods in the alternating-current field which now have extensive radio applications."

The editorial board of *The American Journal of Cancer* gave a dinner at the New York Athletic Club on April 5 in honor of Dr. Joseph Colt Bloodgood, professor of surgical pathology at the Johns Hopkins University and president of the American Association of Cancer Research, on the evening before his departure for a lecture tour in Europe.

Dr. Alexander Oliver Rankine, professor of physics in the Imperial College of Science and Technology, was elected president of the Physical Society, London, on March 19, at the annual meeting of the society. He succeeds Sir Arthur Eddington, whose name was added to the list of ex-presidential vice-presidents. Mr. T. Smith was elected a vice-president in place of Professor Rankine; the secretaries, foreign secretaries, treasurer and librarian were reelected,

and Professors J. A. Crowther, H. R. Robinson and G. F. J. Temple were new members elected to the council.

The coordination of scientific terminology has been considered by a committee which met recently at the International Institute of Intellectual Cooperation, Paris. The committee consisted of Professor Cabrera (Madrid), chairman; Professor Cotton (Paris), representing the International Union of Physics; Professor Willstatter (Munich); Professor Lowry (Cambridge), representing the International Union of Chemistry; Professor Selys-Longchamps and Dr. Ledoux (Brussels), representing the International Union of Biological Sciences, and Professor Lombardi (Rome), representing the International Union of Electrotechnics.

Dr. R. W. Thatcher, president of the Massachusetts State College at Amherst, has resigned owing to ill health, his resignation to take effect next September. After he has had the opportunity for rest he will become, early in 1933, research professor in the experiment station.

Dr. E. K. Marshall, professor of physiology in the School of Medicine of the Johns Hopkins University, has been appointed professor of pharmacology and experimental therapeutics to fill the chair made vacant by the retirement of Dr. John J. Abel.

Due to ill health, Dr. Jacob Diner has retired as the active dean of the College of Pharmacy, Fordham University, but will remain as dean emeritus. Dr. James H. Kidder has been appointed dean.

Dr. Harry B. van Dyke, professor of pharmacology, University of Chicago, has been appointed professor and head of the department of pharmacology at Peiping Union Medical College, Peiping, China, effective about August 1. Dr. van Dyke has been a member of the faculty of the University of Chicago since 1924.

Dr. R. S. Hutton, director of the British Non-Ferrous Metals Research Association, has been appointed the first Goldsmiths professor of metallurgy at the University of Cambridge.

Mr. A. C. Carlton has been appointed curator of geology and the mineral industries of the Museum of Science and Industry of Chicago.

Dr. Helen C. Coombs, of the department of physiology of the New York Homeopathic Medical College, has received a grant of $575 from the Committee on Scientific Research of the American Medical Association for the study of blood changes in experimental epilepsy.

Dr. Wendell C. Bennett, assistant curator of anthropology at the American Museum of Natural History, has arrived in La Paz to undertake a study of the prehistoric ruins at Tiahuanacu and of other Bolivian ruins. Dr. John C. Phillips is collaborating with him.

Mr. S. F. Markham, secretary of the British Museums Association, is traveling in East and South Africa, making a survey of museums.

Dr. Alfred Sturtevant, of the California Institute of Technology, will lecture on genetics and experimental zoology at the University of Birmingham during the autumn term, at the University of Leeds during the second term, and at Armstrong College, University of Durham, Newcastle, during the third term. Dr. Sturtevant is one of two lecturers appointed by the Carnegie Endowment for International Peace to be visiting members of staff in residence at British newer universities for the academic year 1932–33.

Dr. Curt Stern has been appointed visiting professor of biology at Western Reserve University for the coming summer session June 20 to July 29. Dr. Stern will conduct a course on "Recent Advances in Genetics" and one on "The Genetics of Drosophila."

Colonel Charles F. Craig, U. S. Army, retired, professor of tropical medicine and head of the department of tropical medicine at the School of Medicine, Tulane University, New Orleans, gave a Mayo Foundation lecture at the Mayo Clinic, Rochester, Minnesota, on March 29. His subject was "The Amoebiasis Problem."

The annual Sigma Xi lecture at the Kansas State College, Manhattan, was delivered by Dr. Robert Hegner, professor of protozoology in the School of Hygiene and Public Health, the Johns Hopkins University, on April 5. He spoke on "Host-Parasite Relations of Human Protozoa."

Mr. John A. Maloney, assistant to the director of the Museum of Science and Industry, Chicago, gave an illustrated lecture at the University of Illinois College of Medicine on April 6, on "The Museum of Science and Industry."

Dr. M. C. Merrill, chief of publications, U. S. Department of Agriculture, delivered an address on "What Your Government is doing to Enrich Rural Life" before the Brooklyn Institute of Arts and Sciences on April 1.

Dr. Ludwig Pick, honorary professor of pathological anatomy at the University of Berlin, will deliver the seventh Harvey Society Lecture at the New York Academy of Medicine on April 21. His subject will be "Pathological and Clinical Problems in the Study of Osteomalacia."

THE tenth William Thompson Sedgwick Memorial Lecture was given at the Massachusetts Institute of Technology on April 8 by Dr. William G. Savage, county medical officer of health, Somerset, England, on "Some Problems of Salmonella Food Poisoning."

THE first series of the Thomas W. Salmon Memorial Lectures, established in January, 1931, is being given by Dr. Adolf Meyer, Baltimore, on April 8, 15 and 22, at the New York Academy of Medicine on the general subject "Psychobiology." The Salmon Lectures were established in memory of Dr. Thomas W. Salmon, professor of psychiatry at Columbia University College of Physicians and Surgeons and first medical director of the National Committee for Mental Hygiene, who died on August 13, 1927. A fund of $100,000 was subscribed to be administered by the New York Academy of Medicine.

THE Federation of American Societies for Experimental Biology will meet at the University of Pennsylvania, Philadelphia, from April 27 to 30 with headquarters at the Hotel Pennsylvania. On April 27 the members are invited to visit the laboratories of Jefferson Medical School, Hahnemann Medical College, Temple University School of Medicine and Women's Medical College of Pennsylvania. There will also be meetings of the executive committee of the federation and of the councils of the societies. On Thursday, April 28, at 10 A. M. there will be a joint session of the federation, followed by scientific and business sessions of the societies. On Friday, April 29, in addition to the scientific and business sessions of the societies there will be joint demonstrations and at 3:30 P. M. a general meeting of the American Society of Biological Chemists. At 7 P. M. the annual banquet of the federation will be held at the Hotel Pennsylvania. On Saturday, April 30, there will be scientific sessions and a joint session of the federation. Meetings of the following societies will be held, at which members of the federation who wish to attend will be welcome: The American Association of Pathologists and Bacteriologists, the American Association of Immunologists, the American Association for Cancer Research and the International Association of Medical Museums. The meetings of the American Association of Pathologists and Bacteriologists will continue through Thursday and Friday.

THE twenty-fifth annual meeting of the Illinois State Academy of Science will be held on Friday and Saturday, May 6 and 7, at the University of Chicago. The two-day sessions will comprise both general and sectional meetings as well as special inspection trips to the New Oriental Museum at the University of Chicago, the Field Museum of Natural History, the Adler Planetarium and the Shedd Aquarium. The address of the retiring president, Dr. Fay-Cooper Cole, of the University of Chicago, on "The Coming of Man," will be delivered at 7:45 P. M. on Friday, May 6, immediately following the annual dinner of the society, which will take place at the Shoreland Hotel, near the university campus. The meeting will officially begin at 9:30 A. M. on May 6, when Dr. Robert Maynard Hutchins, president of the University of Chicago, will deliver the address of welcome, opening the general sessions at Mandel Hall, to which the public will be admitted. Dr. Cole will respond and will be followed by Dr. M. M. Leighton, chief of the State Geological Survey, who will speak on "Twenty-five Years of the Academy of Science"; other speakers on the general program will be Dr. J Harlen Bretz, of the University of Chicago, whose address will be on "The Glacial History of the Chicago Region," and Dr. L. E. Sawyer, extension forester, of the State Natural History Survey, who will speak on "The National Forest Movement in Illinois."

THE ninth annual meeting of the West Virginia Academy of Science will be held at Concord State Teachers College, Athens, West Virginia, on April 29 and 30. A general session will be held on the morning of April 29, while the afternoon will be devoted to sectional meetings. In the evening an illustrated lecture will be given by the visiting speaker, Professor H. P. Robertson, of Princeton University. Saturday morning, following a brief business meeting, excursions will be made to points of interest in the vicinity of Athens.

THE Louisiana Academy of Sciences held its fifth annual meeting at Centenary College, Shreveport, on April 1 and 2. At the meeting of the academy last year it was voted that a gold medal be awarded for the best paper read before the academy at its annual meetings. This is the first year the medal has been awarded. Professor Hamilton Johnson, of the Louisiana State University, received the award for his paper on "A New Cycle of Operation for Internal Combustion Engines." The next meeting of the academy will be held at the Louisiana Polytechnic Institute at Ruston in the spring of 1933.

THE first and final accounting in the estate of Dr. Richard A. F. Penrose, who died last July, shows a balance for distribution of $8,909,457. The account, filed in the Register of Wills' office, list disbursements aggregating $1,238,057, of which inheritance taxes paid to the Commonwealth of Pennsylvania amount to $903,509. Dr. Penrose's will, after giving $25,000 to his secretary, $85,000 in specific charitable bequests and making other small bequests, left the residue to be divided equally between the American Philosophical Society and the Geological Society of America. Each will receive approximately $4,300,000.

THE condition of the Rockefeller Foundation's offer of $6,000,000 for the construction of a model faculty of medicine in Paris was that a similar sum should be raised in France. It is said that there was every prospect until a few months ago that the necessary contribution would be forthcoming from the French Government in the form of a credit allocated under the national equipment plan voted by Parliament. No such provision was made, however, for the reason that agreement had not been reached on the question of where the proposed laboratory and other new buildings should be constructed.

DISCUSSION

THE FIFTH FLORIDA WHALE SHARK—1932

SINCE the capture of the fourth whale shark at Marathon, Florida, in June, 1923, reports have been coming in of others seen in the Keys and in the Gulf Stream between Miami and the Bahamas. However, all efforts to get definite information about these have been in vain. Recently an 18-foot specimen was taken off Miami and the facts have been gathered to make a new faunal record, the fifth for Florida waters and the seventh for that general locality—the Straits of Florida.

The first news of this fish that reached the American Museum was a telegram which simply read: "Huge shark captured here. Do you want it?" From my personal knowledge of Florida sharks, I judged this shark to be first a great hammerhead (*Sphyrna zygaena*), secondly a huge tiger (*Galeocerdo tigrinus*) and lastly and most improbably a whale shark. Hence I was not very much excited, and when the identity of the shark was ascertained twenty-four hours had passed and it was too late to do anything. However, as will be seen the skin has been preserved and will be mounted.[1]

On January 18, 1932, Captain Thomas Gifford took a party of anglers in his boat out in the Gulf Stream off Miami for a day's fishing. About 2 P. M., while about 30 miles south of the entrance to Miami Harbor, the mate, James O'Neil, saw a large fish, and the vessel's course was set to intersect that of the shark. When the huge fish crossed the vessel's bow it was thought from its color to be a huge leopard or tiger shark (*Galeocerdo tigrinus*). But when Captain Gifford went out to the harpooning "pulpit" on the bowsprit he saw that it was a whale shark (*Rhineodon typus*) with which he and other Florida sailors are somewhat acquainted by reason of various captures of late years in the Florida Keys.

In the excitement over its great size (great in comparison with that of other Florida sharks) and the unusual coloring (vertical yellowish bars separating vertical rows of large yellowish spots), the first throw went wild. The second, however, struck the whale shark in its most vulnerable part—the gill region. The harpoon—one used for striking sailfish—though bent, held, and the fish towed the boat a considerable distance out into the Gulf Stream. Presently, however, it began to weaken from loss of blood and to work toward shore. As it grew weaker, it was drawn up to the boat, lashed fast, and with much resistance was towed into the yacht basin at Miami. Later by means of block and tackle it was swung up clear of the water and photographs were made of it hanging clear.

The fish was harpooned in water about 25 feet deep in the edge of the Gulf Stream, but the capture was made near Beacon O, between Cape Florida and Sand Key, in water between five and ten feet deep. Like other Florida specimens this fish put up no fight other than to tow the boat around in trying to escape. Being of relatively smaller size (18 feet over all) and because of loss of blood by reason of being harpooned in the gills, it offered less resistance than larger specimens harpooned in the back, and was lashed to the boat for towing after about three hours' effort to escape. Three hours more were required to tow it into the yacht basin at Miami, some 25 miles distant.

Mr. Pflueger made a plaster cast of the fish while it was fresh and secured the skin. As noted there were excellent photographs made of the fish swung up by the tail. With the help of these things Mr. Pflueger plans to mount the skin in fashion as near to nature as possible.

The length is variously given as 17 feet, 8 inches, to 18 feet, 6 inches. Various estimates have been made of the weight of the fish, the liver and the heart; but, as they are all merely estimates, they will be disregarded. Mr. Pflueger opened the stomach but found therein nothing but seaweed and a great quantity of partly digested and hence unrecognizable food material.

This is the fifth Florida whale shark and the seventh for this general region—the Straits of Florida. The first specimen (18 feet long) came ashore on Ormond Beach on January 25, 1902. The second (32 feet long) was taken near Knight's Key in May, 1912

[1] For the information and for photographs of the fish on which this note is based I am indebted to my friends, Commodore R. M. Munroe of Cocoanut Grove and Mr. John Mills of Miami, and to Mr. Albert Pflueger taxidermist and naturalist of Miami.

The third was 31 feet over all and was captured in the Bay of Florida in June, 1919. The fourth (31.5 feet in length) was harpooned at Marathon in June, 1923. This, the fifth specimen, was taken on January 18, 1932. In addition, two specimens have been captured off Havana Harbor. The first (32 feet long) was taken west of the mouth of the harbor in 1927; the second (about 34 feet in length) was caught east of the harbor mouth in March, 1930. All these fish, save the first, I have put on record but only after the receipt of photographic evidence. Such data have come for this specimen, and since one photograph is the best ever made, I hope later to publish it and others and thus make them available for the use of ichthyologists.

These seven captures in the region of the Straits of Florida indicate that there is a breeding ground somewhere to the southwest from which the fish drift northeast with the Gulf Stream. From various data coming to me over a period of years, I am convinced that this is somewhere in the Yucatan region. The reasons for this are set out in a recent paper of mine,[2] to which the attention of those interested in this particular matter is called.

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THE WHALE SHARK ON THE COAST OF BORNEO

DARVEL BAY is a large indentation on the northeast coast of British North Borneo. In the jungles behind its flat sandy shore live deer, wild boar, tambadu or huge wild ox, elephant and rhinoceros.

Last summer I discovered that the waters of the bay held monsters even greater than anything on its shores. As the Philippine revenue cutter, *Mindoro*, entered Darvel Bay from the Sulu Sea on August 4, 1931, my friend, the Spanish engineer of the boat, spoke to me of the great "chacon" and its mate which were always seen whenever the *Mindoro* passed that way. To my surprise, while we were talking about it a great whale shark broke water and swam about on the surface, perhaps a little more than two hundred yards away. It was a typical specimen of *Rhineodon typus*, the white spots and longitudinal ridges being more distinct than I had ever seen them before. We estimated the length of the "chacon" to be between 12 and 15 meters.

Our boat was running parallel with the flat sandy coast, and we soon left the great shark behind, as it was merely circling about. Perhaps a quarter of a mile further on another whale shark broke water but did not emerge sufficiently to show its spots. Only its gigantic size, equal to that of the one seen first, told what it was.

The *Mindoro* frequents these waters during several months each year, while watching for smugglers, and anchors not far from the place where we saw the sharks. The engineer told me that he had seen these two sharks almost every time the ship had passed the point during the past fifteen years.

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DETERMINISM AND THE WEATHER

IN commenting on Professor Compton's[1] remarks on the uncertainty principle and free will, Professor Noyes[2] has contributed to clarity of thought and discussion by pointing out the important distinction between events which are indeterminable and those which are indeterminate. The illustration he has chosen, however, seems to imply a view of causation which calls for a certain amount of comment. He says: "I think no scientific man would claim that because the weather is indeterminable it is indeterminate—that the weather to-morrow will not depend, inevitably, on conditions which exist to-day." On the contrary—be it said for whatever measure of philosophic comfort weather forecasters may derive therefrom—I think that a considerable number of scientific men would decline to commit themselves to any such statement, for excellent reasons which Hume pointed out nearly two centuries ago. Sequence of events, however oft repeated, affords no proof of causal connection. The best that can be said, from the strictly critical standpoint, is that the weather to-day is related to the weather to-morrow through a chain of intermediate unknown events which, if we were able to find them out, we should be likely to naïvely regard as establishing a causal connection.

If it be objected that this strikes at the root of all scientific method, it may reasonably be replied that the scientist should himself be the most eager to examine critically the bases of his own procedure. Such an examination is inevitable when the boundary between physical science and metaphysics becomes as indefinite as it is at the present time.

It may be admitted that there are excellent pragmatic reasons for assuming a causal connection between events or series of events characterized by a high degree of statistical correlation (the relation of the weather on two successive days is not the best example of this!), but it should be pointed out that this assumption does not justify the ordinary idea

[2] E. W. Gudger, "The Fourth Florida Whale Shark, *Rhineodon typus*, and the American Museum Model Based on It." *Bulletin American Museum of Natural History*, 61: 630–632, 1931.

[1] A. H. Compton, SCIENCE, 74: 172, 1931.
[2] W. A. Noyes, SCIENCE, 74: 595, 1931.

that the event which precedes in time is the cause, while that which follows is the effect. We are quite as justified in saying that the weather to-morrow is the cause of that to-day as in saying the opposite. Any one to whom the logic of this is not self-evident is invited to reread "Alice in Wonderland, or Through the Looking Glass." When we say that two events are causally related, all that we can mean from either the philosophical or scientific standpoint is that there is a high degree of probability that one will not occur without the other.

It is a commonplace of probability theory that empirically determined laws are liable to violation. When the probability of such violation is slight, we are prone to disregard it, but on very much the same basis that we disregard the probability of being killed by slipping in the bathtub. This admittedly may happen, but we continue to take baths and hope for the best.

The "collapse of causality" alleged to result from the uncertainties of quantum theory has been variously received by different segments of the scientific world—with alarm and consternation, with resignation or despair, or with an enthusiasm born of the hope that it offers new arguments for human freedom. It is difficult to see how any of these points of view is justified. The principle of causation is just as valid as ever for practical purposes, while from the philosophical standpoint it never had any validity. Therefore it would seem that matters remain *in statu quo*.

If quantum theory has rendered any service to the cause of free will, it is primarily that of showing that some of the reasons for believing in determinism are not as good as was formerly supposed. At present each hypothesis seems to rest on the somewhat precarious ground that the other can not be shown to be true. Without discounting his own prejudices in the matter, the present writer leans to the view that determinism labors under the disadvantage of requiring a greater number of assumptions in regard to the behavior of unknowns. In other words, the conservative attitude is to emphasize that events which are indeterminable are indeterminate as far as we know. It requires an extraordinary extension of the scientific method to assert what would be true if we knew all the facts in the case.

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ON "ACADEMIC FREEDOM IN ITALY"

IN SCIENCE for March 25 Dr. A. J. Carlson, head of the department of physiology, University of Chicago, asks American biologists not to attend the next International Congress of Physiology, which is scheduled to meet in Rome next August, "unless the brutal and defiant attack on academic freedom on the part of the Italian government is rescinded." The "attack" is the oath of loyalty required by the government from the professors of the Royal universities. I wish to make, in this connection, some statements of facts, which are perhaps not well known, or have often been overlooked in the discussion on the subject.

The Italian universities are classified in three categories, namely, universities entirely supported by the state; universities largely supported by the state and partially by private contributions, and private universities, which do not receive any financial help from the state. The oath is demanded only from the professors (including associates, assistants, etc.) teaching in universities belonging to the two first categories, *i.e.*, from the official instructors maintained by the state. The professors of private universities are, of course, entirely free from such an obligation; a large number of them, however, offered spontaneously to take the oath. As it has been published, twelve, out of a total number of 1,225 professors, refused to take it. Does Dr. Carlson think that the remaining 1,213 took the oath against their conscience? Did he realize that the attitude that he suggested implies an insult toward the very men he seems so anxious to defend?

An oath of loyalty and allegiance to the King, the fatherland and the laws of the state has been required since the time of the constitution of the Kingdom of Italy from every person taking any office in direct dependence on the state. After the advent of the Fascist régime, which represents now the Italian State, the phrase ". . . and to the Fascist régime" was added to the prior formula. The formulae are essentially the same for every category of officials, but may vary somewhat, according to the specific functions which shall be exercised. For the university professors, the sentence concerning their functions is the following: ". . . and (I swear) to exercise the teaching function and to fulfill all academic duties with the purpose of forming citizens active, honest and devoted to the fatherland and to the Fascist régime." The entire formula has already been published in SCIENCE (Jan. 15, p. 73), but evidently in the translation the meaning of the Italian word "probo," *i.e.*, honest, has been confused with "prode," *i.e.*, bold.

The statement of a group of Harvard professors (SCIENCE, *ibid.*), namely, "This decree imposes upon all university professors of the Kingdom of Italy—and among all state officials of the Department of Education it is applicable to university professors alone—the obligation to take an oath which implies complete adherence without reservation or discussion to a particular system of political ideas," is thus somewhat misleading, since all state officials are ob-

liged to take the oath, and not all the university professors.

The Fascist régime, so far as the theory is concerned, undoubtedly is to be considered "a particular system of political ideas," as every other régime in the world. Actually, however, it represents the Italian state as recognized by far the greatest majority of citizens. The state requests its officials, who are supposed to apply its laws and to make the citizens respect them, to take an oath of allegiance, as a means of prevention against the danger of maintaining in dependence on it men whose activity is contrary to the safety of the state itself. This is, I believe, the general procedure in every country. In the United States, for instance, an oath of "true faith and allegiance" to the Constitution, implying the condition to "support and defend the same against all enemies, foreign and domestic," and to be taken "without any mental reservation or purpose of evasion" is required from "any person elected or appointed to any office of honor or profit in either the civil, military or naval service," and, apparently, whatever his personal political ideas may be. Furthermore, examples of states directly defending themselves against professors who are supposed to exercise dangerous political propaganda are very common everywhere, and are well known.

There is not in Italy any limitation whatsoever to discussion and research work in any particular or general biological theory or field; also no restriction from either the civil or ecclesiastical authorities, and this is not the case in every country. Therefore, there is no reason whatever for supposing that a scientific discussion in the field of biology could not enjoy the utmost freedom. A refusal to attend the physiological meeting would only result in a boycott, on the part of American biologists, of the hospitality that the Italian scientists (whose own consciences have allowed them to take the oath) are preparing for their colleagues of the world.

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Assistant Professor,
University of Rome
Research Fellow for 1931–32,
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ACADEMIC FREEDOM IN SPAIN

Dr. Carlson's proposal to boycott the International Physiological Congress at Rome as well as Dean Pound's protest to the League of Nations because of the attack on academic freedom in Italy suggests that some similar action be taken by American educators in protesting the much more brutal attack on this same right by the Spanish government in regard to the Jesuit Order. For, whether one agrees with the aims of this teaching body or not, the principle at stake is the same, namely, academic freedom, which has suffered a serious blow not only by the law forbidding members of the Society of Jesus to teach in Spain but by the outright confiscation of their twenty-six colleges serving 14,599 students. Among these institutions were many which were doing notable work in science, especially the Chemical and Biological Institutes of Sarriá (Barcelona) and the Engineering Institute in Madrid.

Particularly obnoxious was the proposal of the government to Father Rodés, director of the Observatory of the Ebro, one of the world's few stations for the study of terrestrial magnetism, to continue his work until they could prepare a staff to replace him and his assistants.

Those who have found fault with Spain because of its backwardness in things scientific will resent this further handicap to progress in science and will add a protest against it to the one against the attack of the Fascist régime on academic freedom in Italy.

Spring Hill College P. H. Yancey, S.J.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

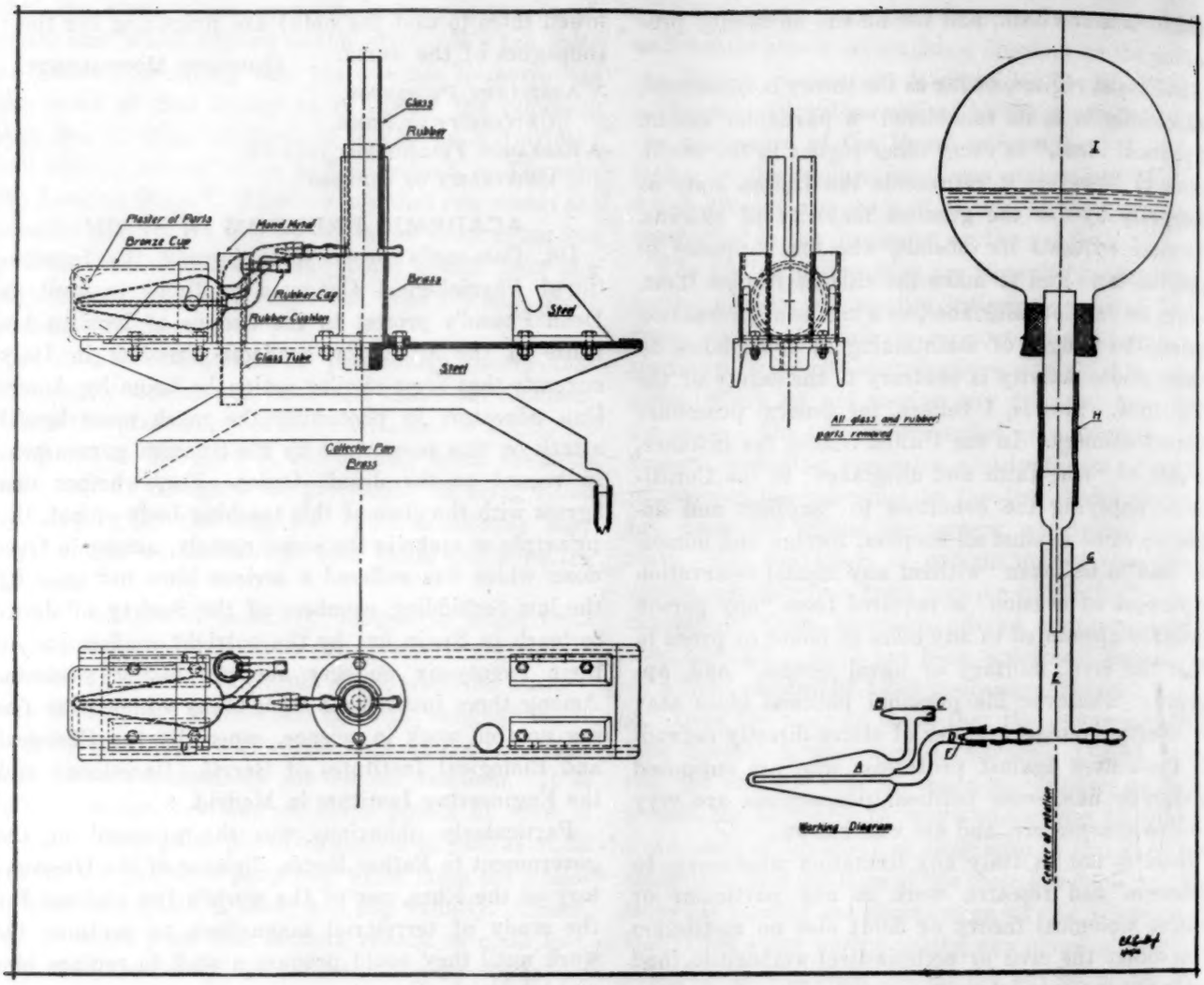
A METHOD FOR WASHING CORPUSCLES IN SUSPENSION

The original fluid may be replaced and corpuscles washed while still in suspension during centrifugation. This is accomplished by placing the suspension in a conical chamber (A). During centrifugation, the replacement fluid is introduced at the outer and narrow end of the chamber while the replaced fluid is forced out at the inner and wider end. The chamber is so designed that, when properly operated, the rate of flow at the narrow end is too rapid to permit the settling and packing of the corpuscles, while at the wide end it is too slow to carry them out with the replaced fluid. The corpuscles, therefore, remain suspended in the middle of the chamber.

Technique

The conical chambers (A) are filled and inserted in the centrifuge head. These are so designed that all connections are made automatically as they are placed in their guides. An injector tube (G) from an inverted flask (I) containing the replacement solution is clamped in position in the center of the intake chamber (E). The position of the mouth of this tube regulates the height of fluid in the intake chamber.[1] A clamp on the rubber connection (H)

[1] When only one conical chamber is used or when accurate distribution is not essential, the jets (F) may be replaced by full sized glass tubes and the rates of flow of replacement fluid regulated by a jet or valve before it is introduced into the intake chamber. In this case



to the flask (I) prevents the fluid from flowing out. The centrifuge is started and run at full operating speed long enough to permit the corpuscles to settle away from the outlet of the chamber (A). The clamp on the flask connection is then removed and the replacement fluid permitted to flow into the intake chamber. The rate of flow to each conical chamber is regulated by the size of the jets (F) leading to them. The overflow is carried to a collector pan below the centrifuge head. When the desired washing or dilution has been obtained, the flow of replacement fluid is cut off and the centrifuge stopped by applying the brake. The conical chambers are removed from their guides and the suspension of corpuscles may be poured out through the vent tube (C). The corpuscles come in contact with glass only. All vessels and tubes which come in contact with the replacement fluid are glass and their connections rubber.

The rate of replacement and washing depends upon the suspension to be washed and the centrifugal force used. In a first test, a 90 cc solution containing corpuscles in suspension and .02 per cent. phenol red was centrifuged at approximately 650 times gravity at the maximum cross section of the conical chamber. After one minute, the replacement fluid was permitted to flow through the chamber at the rate of 60 cc per minute. At the end of fifteen minutes, the dilution of the indicator showed that only a fraction of 1 per cent. of the original fluid still remained.

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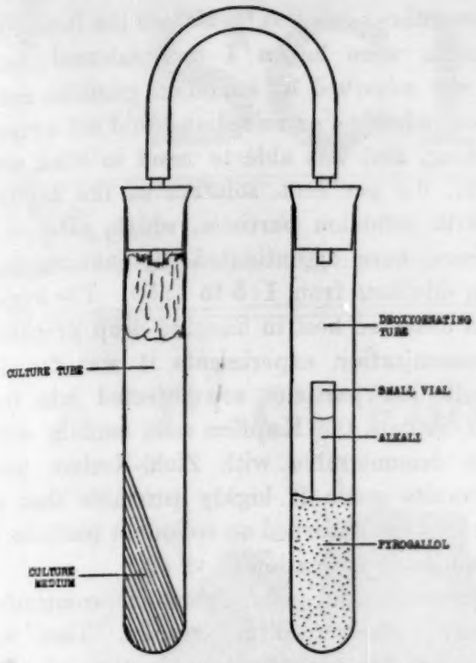
MEDICAL RESEARCH

it is convenient to keep the mouth of the injector tube close to the top of the intake chamber. When one of the conical chambers is not in use the jet is replaced with a closed tube and the chamber filled with fluid of proper density to maintain balance.

A MODIFICATION OF THE BUCHNER METHOD OF CULTIVATING ANAEROBIC BACTERIA

THE apparatus illustrated in the accompanying diagram has been tested thoroughly in connection with our work and has been found very effective for the cultivation of microaerophilic bacteria, at the same time eliminating several of the difficulties involved in using the usual Buchner tube.



The diagram is almost self-explanatory. Deoxygenation is obtained by the use of an alkaline solution of pyrogallol. It has been our custom to use enough pyrogallol to form a solid block of about one and one-half inches in a 5 × ⅝ test-tube. The alkali (sodium hydroxide or potassium carbonate) is pipetted into the small vial in the deoxygenating tube and the connections are made as shown. The deoxygenating tube is then tipped to allow the alkali to mix with the pyrogallol. In performing this procedure it is well to have the mouth of the deoxygenating tube low enough to prevent flow of the solution across to the culture tube.

It is possible to open the culture tube several times for examination without renewing the deoxygenating tube by clamping the connecting tube securely. We experimented a number of times with methylene-blue control tubes and found that this procedure could be followed from 4–6 times safely.

Unless the outfit is to be used continuously for more than a week, it is not necessary to seal the connections. When it is desirable to seal the apparatus, collodion is found to be the most suitable material. The collodion should be allowed to dry before deoxygenating the system, otherwise ether fumes may be drawn into the tube, killing the organisms.

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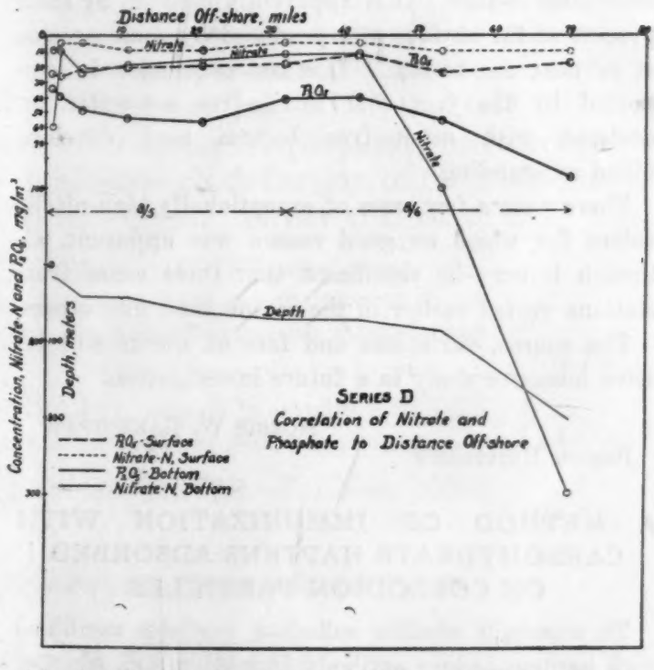
SPECIAL ARTICLES

PHOSPHATE, NITRATE AND NITRITE IN THE SEA-WATER OF REGIONS ADJACENT TO CAPE COD

THE first objective in the chemical program undertaken at the Woods Hole Oceanographic Institution, during the summer of 1931, was a general survey of the waters of the Woods Hole region with respect to their phosphorus and nitrogen content, and especially a comparison of the inshore or neritic waters with the oceanic water found at or near the Continental Slope. The broad shelf to the south of Martha's Vineyard and Nantucket offered a particularly favorable opportunity to study this latter point.

For this purpose two series of stations were established in this area: one, Series D, extending seventy miles to the south of Block Island to the edge of the Continental Shelf, and another Series A, to the south of Martha's Vineyard in a similar manner. Water samples were taken from the surface, bottom and intermediate depths at stations of varying distances from shore. Phosphate, nitrate and nitrite were determined by standard analytical methods.

The samples from Series D were taken on a single trip, covering a total time of less than two days. The results are shown in Fig. 1, correlating the phosphate and nitrate content, both surface and bottom,



with the depth of water and distance off-shore. The most significant feature is the increase in phosphate, and more particularly nitrate, found at the bottom as the Continental Slope is approached. The distinction between "oceanic" and inshore water, not only in this series of stations but in others as well, is to be found in the concentrations of phosphate, and more especially nitrate, at the bottom.

The thirteen stations in Series A were visited at various times during the summer, and consequently the results do not represent a continuous profile. They indicate that water movements of a very fundamental sort take place. This is especially noticeable in the vicinity of the slope, where the influence of oceanic water varies over many miles, extending considerably further inshore at some times than at others.

Phosphate and nitrate concentrations at inshore stations, not only in these two series but in others in Vineyard Sound and Buzzards Bay, were found to be variable, even over comparatively short periods of time. This is to be expected from the continuous movements of water due to tidal currents, etc., and is in accord with similar results obtained by the author in the neritic waters of the Gulf of Maine. It is evident that inshore waters can not be distinguished or characterized in terms of their phosphate or nitrate content.

The interpretation of the variations in nitrite is a problem in itself. With a few significant exceptions the following general principles seem to be true: Nitrite is seldom, if ever, found at the surface, and almost always found at the bottom, although there is usually not a very high concentration at the bottom of oceanic stations. It is exceedingly variable from time to time. It is apparently used up by some process at the surface and produced by some process at or near the bottom. This last conclusion is supported by the fact that nitrite-free sea-water inoculated with nitrite-free bottom mud develops nirite on standing.

There were a few cases of exceptionally high nitrite values for which no good reason was apparent, although it may be significant that these came from stations visited earlier in the season than any others.

The source, variations and fate of nitrite will receive intensive study in a future investigation.

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A METHOD OF IMMUNIZATION WITH CARBOHYDRATE HAPTENS ADSORBED ON COLLODION PARTICLES

To ascertain whether collodion particles combined with haptens induce antibody formation, *i.e.*, whether haptens can be made antigenic by adsorption on nonprotein inert particles I injected 2 rabbits, in 1930, with collodion particles treated with purified type-specific substance of pneumococcus type I.[1] The results were negative. In May, 1931, I started similar experiments with a carbohydrate solution prepared from the anthrax bacillus.[2] Before the immunization experiments were begun I demonstrated that the hapten was adsorbed by collodion particles and that the hapten adsorbed on collodion could not be removed by washing, and was able to react in vitro with its antibody. 0.5 per cent. solution of the hapten was mixed with collodion particles, which, after washing four times, were agglutinated by anthrax-immune serum in dilutions from 1:5 to 1:50. The agglutination was observed best in hanging-drop preparations.

In immunization experiments it was found that when collodion particles are injected into the ear veins of rabbits the Kupffer cells contain collodion particles demonstrable with Ziehl-Neelsen method.[3] These results made it highly probable that carbohydrate haptens adsorbed on collodion particles would induce antibody formation in vivo.

Subsequently and after personal communication Dr. Zozaya reproduced my results. Then we immunized rabbits[4] with the combination of collodion and haptens. Later the work was continued independently.[5]

In one of three rabbits injected with collodion coated with anthrax-carbohydrate the serum gave a faintly positive precipitin reaction with the solution of anthrax-carbohydrate. Rabbits injected with collodion particles coated with the specific substance from pneumococcus type III[6] did not produce agglutinins or precipitins. Work with other haptens and adsorbents is in progress.

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[1] The preparation was obtained through the kindness of Dr. M. Heidelberger.

[2] The hapten preparation was given to me at my request by Dr. J. Zozaya, of the H. K. Mulford Co.

[3] J. Freund, *Amer. Rev. Tuberc.*, 12, 124, 1925; J. Freund, *Proc. Soc. Exp. Biol. and Med.*, 28, 65 and 1010, 1930; J. Freund, *J. Exper. Med.*, 55, 18, 1931; S. Mudd, B. Lucke, M. McCutcheon and M. Strumia, *J. Exper. Med.*, 52, 313, 1930.

[4] J. Zozaya, SCIENCE, 74, No. 1915, p. 270, Sept. 11, 1931.

[5] J. Zozaya, *J. Exper. Med.*, 55, 325, 353, 1931.

[6] The hapten preparation was obtained through the kindness of Drs. Avery and Goebel.